



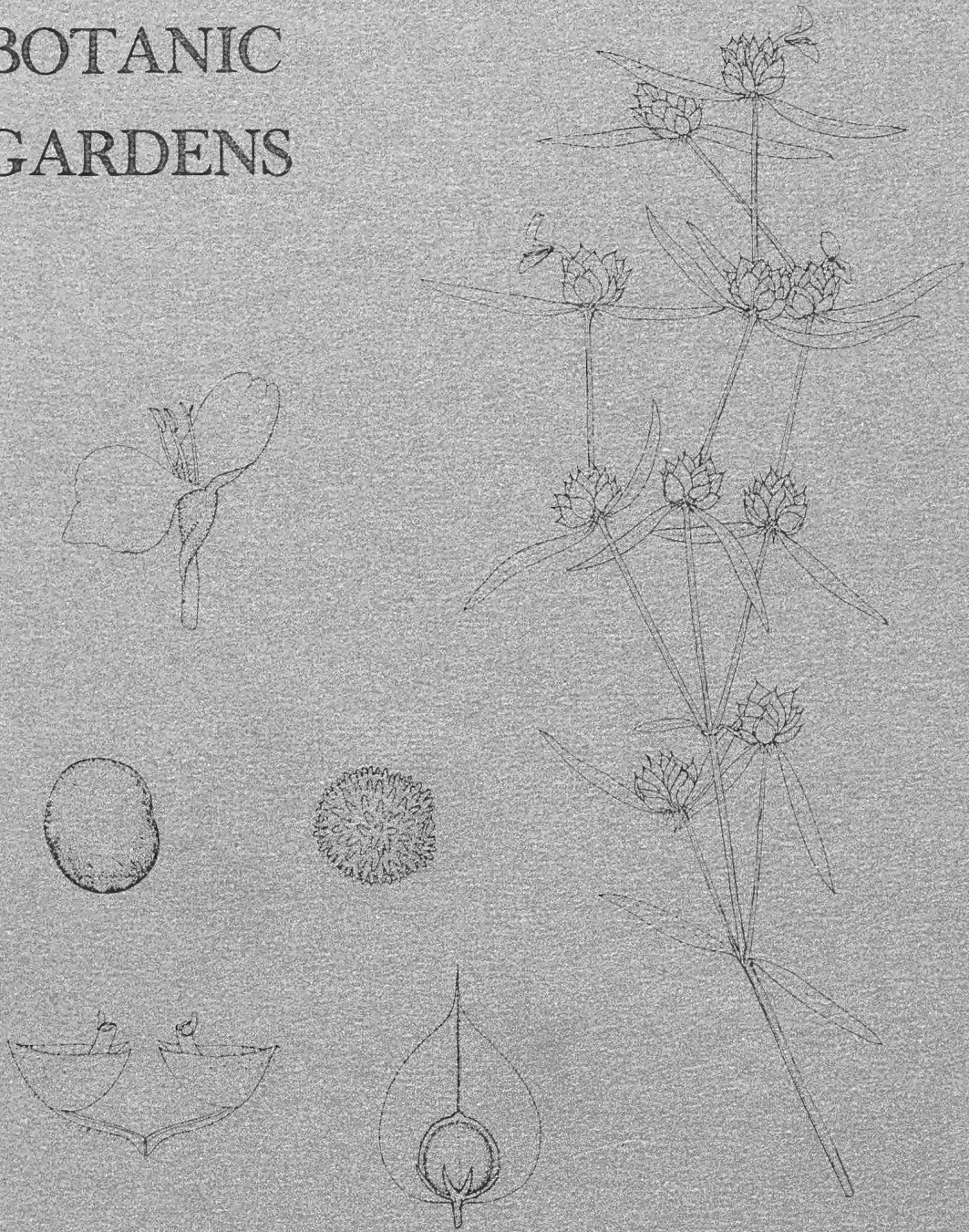








# JOURNAL of the ADELAIDE BOTANIC GARDENS



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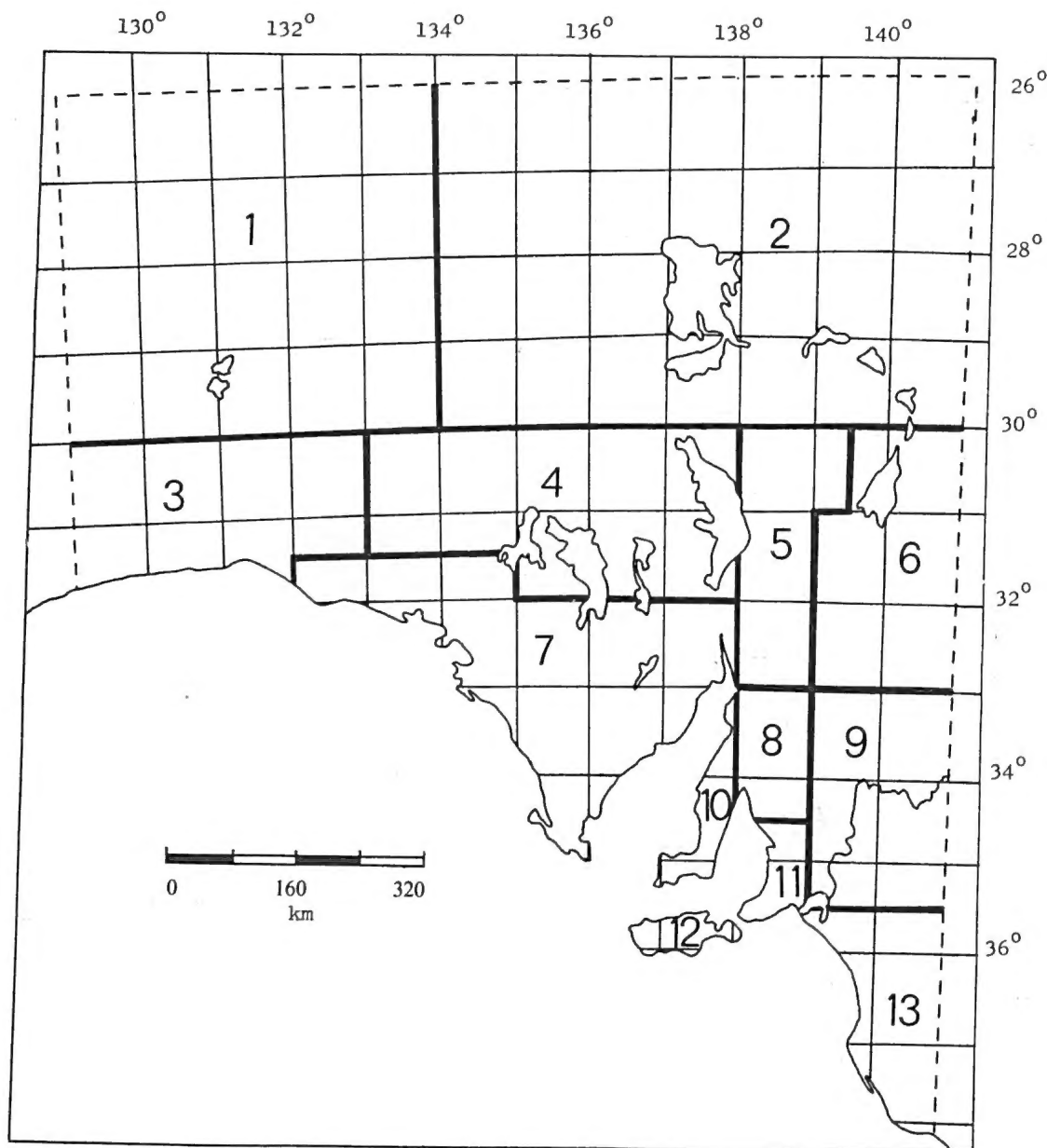
# JOURNAL of the ADELAIDE BOTANIC GARDENS

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| 2. Lake Eyre Basin        | 9. Murray           |
| 3. Nullarbor              | 10. Yorke Peninsula |
| 4. Gairdner-Torrens Basin | 11. Southern Lofty  |
| 5. Flinders Ranges        | 12. Kangaroo Island |
| 6. Eastern                | 13. South-eastern   |
| 7. Eyre Peninsula         |                     |



# A TAXONOMIC REVISION OF AUSTRALIAN ACANTHACEAE

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c/- State Herbarium of South Australia, Botanic Gardens,  
North Terrace, Adelaide 5000

## Abstract

A revision of 28 native and naturalised genera of Acanthaceae is presented together with keys to infrafamilial, generic, specific and infra-specific taxa. There is a brief history of each genus and the morphology and floral biology of the genera have been discussed in comparative terms. Past infra-familial classifications have been reviewed and the placement of Australian genera within these is considered. Malesian material and literature have been consulted in order to establish correct names as far as possible; where Australian taxa extend into New Guinea, the New Guinea material has been included in the treatment.

*Lepidagathis* Willd., *Hemigraphis* Nees and *Peristrophe* Nees are newly recorded along with the two generic segregates of *Justicia* s.l., *Calophanoides* (Clarke) Ridley and *Rhaphidospora* Nees. A discussion of the generic delimitation within the complexes of genera sometimes placed under *Ruellia* and *Justicia* is presented.

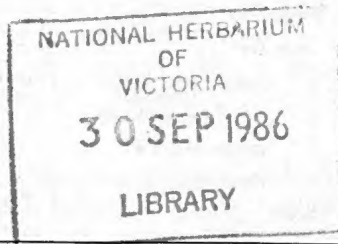
Species reinstated are *Dipteracanthus australasicus* F. Muell. (for *Ruellia primulacea* F. Muell. ex Benth., *Ruellia corynotheca* F. Muell. ex Benth. and *Dipteracanthus corynothecus* (F. Muell. ex Benth.) Bremek. ex W.R. Barker), *Dicliptera armata* F. Muell. (for *D. glabra* Decne.) and *Dicliptera ciliata* Decne. (for *D. aff. leonotis* Dalz. ex C.B. Clarke).

The following new combinations have been made: *Dicliptera australis* (*Brochosiphon australis* Nees), *Isoglossa eranthemoides* (*Justicia eranthemoides* F. Muell.), *Calophanoides hygrophiloides* (*Justicia hygrophiloides* F. Muell.), *Rhaphidospora cavernarum* (*Justicia cavernarum* F. Muell.), *Rhaphidospora bonneyana* (*Justicia bonneyana* F. Muell.) and *Rostellularia adscendens* (*Justicia adscendens* R. Br.). This last name has been reintroduced for Australian material previously referred to *Justicia procumbens* L., *J. clementii* Domin, *J. glaucoviolacea* Domin and *Rostellularia pogonanthra* F. Muell. Within it, var. *latifolia* and var. *hispida* of ssp. *adscendens* are based on varieties described by Domin under *Justicia procumbens* L.

The following new combinations are associated with changes in status: *Dipteracanthus australasicus* F. Muell. ssp. *corynothecus* (*Ruellia corynotheca* F. Muell. ex Benth.), *Rostellularia adscendens* (R. Br.) R.M. Barker ssp. *glaucoviolacea* (*Justicia glaucoviolacea* Domin), ssp. *clementii* and var. *clementii* (*Justicia clementii* Domin) and under ssp. *adscendens*, var. *juncea* (*Justicia juncea* R. Br.), and var. *pogonanthra* (*Rostellularia pogonanthra* F. Muell.).

The following new taxa have been described: *Acanthus ebracteatus* Vahl ssp. *ebarbatus*, *Staurogyne leptocaulis* Bremek. ssp. *decumbens*, *Dipteracanthus australasicus* F. Muell. ssp. *glabrata* and ssp. *dalyensis*, *Brunoniella linearifolia* and *B. acaulis* (R. Br.) Bremek. ssp. *ciliata*, *Xerothamnella herbacea*, *Dicladanthera glabra*, *Dicliptera arnhemica* and *D. miscella*, *Peristrophe brassii*, *Hypoestes sparsiflora* and *H. floribunda* var. *varia*, var. *yorkensis*, var. *velutina*, var. *cinerea* and var. *neoguineensis*, *Sarojusticia kempeana* (F. Muell.) Bremek. ex H. Eichler ssp. *muelleri*, *Rostellularia adscendens* (R. Br.) R.M. Barker ssp. *dallachyi* and var. *largiflorens* of ssp. *clementii* (Domin) R.M. Barker.

All names have been typified and areas where problems are still to be resolved are highlighted.



NOTE: *Dipteracanthus australasicus* ssp. *glabratus* and the new combinations *Rostellularia adscendens*, *R. adscendens* ssp. *clementii*, var. *pogonanthra* and var. *latifolia* have appeared prematurely in Jessop & Toelken, Flora of South Australia edn 4, pp. 1318-1320 published on 1st August 1986. They are not validly published there. As intended (cf. International Code of Botanical Nomenclature 1983, article 34.3), the place of valid publication is within this treatment.

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Introduction

The Acanthaceae of Australia are predominantly tropical or semi-tropical in distribution. As with any tropical Australian plant group, where the taxa are extensions of Malesian distribution ranges, there is often difficulty associated with the application of specific epithets. Malesian plant taxonomy is, on the whole, more fragmented than Australian, both because of the geography of the region and the different nationalities involved in its colonization and botanical study. There is frequently more than one name for a single species and the establishment of the correct epithet can be a time-consuming task.

The Australian taxa have only rarely been reviewed in relation to Malesian species (e.g. Bentham 1868, and to some extent Bremekamp 1955, 1962, 1964). Despite the number of name changes which have been made in this revision of Australian taxa, it represents only a beginning. As with most revisions of families throughout Malesia, it is likely that some further changes will be necessary. This is not to say that Australian taxa are not real, but the status of some species (e.g. *Nelsonia campestris*, *Hygrophila angustifolia*, *Hypoestes floribunda*) and even certain genera (e.g. *Brunoniella* and *Sarojusticia*) may prove to be unjustified when full revisions are carried out.



Tribute should be paid to the work of C.E.B. Bremekamp in the Malesian area. Although my concept of the species and sometimes the genus is usually wider than that of Bremekamp, his work, particularly his notes on the flora of Java (Bremekamp 1948) has provided a framework which has proved invaluable in trying to place Australian taxa.

In choosing to adopt the segregate genera of both *Ruellia* and *Justicia*, I have followed the practice which is usually adopted in Malesia following Bremekamp's work there. This approach differs from that advocated in America and Africa, but until an overall revision of these two generic complexes is attempted there will be controversy about their rank. Whichever approach is adopted, any worker interested in placing a species in *Ruellia* or *Justicia* sensu lato will need to determine the relevant segregate group, whether as a section, subgenus or genus. In using the segregate generic names here, species relationships are immediately obvious and the alternative clumsy forms such as *Justicia (Rhaphidospora) bonneyana* or *Ruellia (Brunoniella) australis* are avoided. As elsewhere (Stearn 1971) the segregate genera are very distinct on a regional basis and their use should not pose any difficulty to workers.

There are three genera apart from segregate genera which are newly recorded for Australia. All three (*Peristrophe*, *Hemigraphis* and *Lepidagathis*) are from Cape York Peninsula and are at this stage, particularly in the case of the last two, represented by very little collected material. Consequently it has been difficult to name them at the specific level, although in the case of *Hemigraphis* and *Lepidagathis* they are almost certainly conspecific with species from New Guinea where these genera are in much need of revision. Material assigned to *Peristrophe* has been described as a new species. Since it lacks one of the generic characteristics and is somewhat atypical of the genus in Malesia it has only doubtfully been referred here.

The two endemic and previously monotypic genera, *Xerothamnella* and *Dicladanthera*, the subtribal placement of both of which is uncertain, have both had a second species added. The most time-consuming tasks were the restructuring of the complexes *Hypoestes floribunda* and *Rostellularia adscendens* (= *Justicia procumbens* or *Rostellularia pogonanthera* of previous authors) and an unsuccessful attempt to do the same for the *Pseuderanthemum variabile* complex. In addition to a number of new taxa within these complexes, new species have also been recorded in *Dicliptera*, *Hypoestes* and *Brunoniella*, together with a number of newly recorded naturalised species for Australia. Name clarifications have been made in a number of genera, and a number of species, previously of uncertain position within *Justicia* s.l., have been placed within segregate genera.

The work was carried out at the State Herbarium of South Australia with the investigations based on collections (including types) from the following herbaria (abbreviations as designated by Holmgren, Keuken & Schofield in 'Index Herbariorum' 1981): AD, ADW, BM, BRI, BRIU, CANB, CBG, DNA, K, L, LAE, NSW, NT, P, PERTH, PR, QRS, UNSW and from Kings Park (cited as KINGS PARK). Material from BM had to be returned before some taxonomic decisions had been finalised so that some of it lacks annotation.

Type material of all Australian native species has been examined, although not all isotypes and isosyntypes have been seen. However in the case of most of the introduced species it was either not possible to locate types or they reside in the Linnaean or de Candolle herbaria, which were consulted on microfiche at AD. Syntypes or holotypes have been seen for some introduced species.

Specimens of New Guinea species of Acanthaceae which also occur in Australia have been studied in conjunction with the Australian collections and where applicable these have been cited within the 'Specimens examined'. The New Guinea material examined was chiefly that of LAE, although the holdings of MEL and CANB have been briefly surveyed.



Some taxa were observed in the field by the author during a trip to the Northern Territory in 1983. There still remains a large amount of field work to be done, particularly in Queensland and the Kimberleys region of Western Australia, but hopefully this revision will stimulate further observations on the species of Acanthaceae, particularly with respect to their breeding systems. Any constructive criticism of the concepts adopted here would be welcome, especially any comments on the species complexes *Pseuderanthemum variabile*, *Hypoestes floribunda* and *Rostellularia adscendens*, and any observations on floral biology.

During a trip to Europe the Australian holdings of K, BM, LY, G, FI, W, WU, M, L and CGE were consulted. Some modifications to the manuscript have been made but the specimens examined on this trip have not been cited, although the majority of the material has been annotated.

### History of the family in Australia

Robert Brown (1810) was the first person to describe members of the Acanthaceae for Australia. His experience of the Australian species was based upon his own collections, made as naturalist on Matthew Flinders' voyage to northern Australia in 1802-3, together with the earlier collections of Banks and Solander. Altogether he recognised seven genera for Australia; these were *Ruellia*, *Justicia*, *Acanthus*, *Eranthemum*, *Hypoestes*, *Hygrophila* and *Nelsonia*, the last three of them being new.

Nees von Esenbeck produced a number of Acanthaceae treatments, but the two most relevant to Australian taxonomy are volume 3 of Wallich's "Plantae Asiaticae Rariores" (Nees von Esenbeck 1832), in which a number of new genera were published, and his work in de Candolle's *Prodromus* (Nees von Esenbeck 1847a) in which a world-wide survey of the whole family was produced. Nees was responsible for establishing the genera *Hemigraphis*, *Graptophyllum*, *Peristrophe*, *Rhaphidospora*, *Anisostachya* and *Ebermaiera* (= *Staurogyne*), although at that time he recognised none of these genera for Australia. He described the small amount of Australian material that he saw either under the name given to it by Brown in 1810\*, or in the case of the *Justicia* species, under *Rostellularia* and the *Ruellia* species under *Dipteracanthus* and *Cryphiacanthus*. The only additional Australian material seen by him, besides that already studied by Brown, appears to have been the collections of Alan Cunningham made on Philip Parker King's surveys of the north coast of Australia in the *Mermaid* between 1817 and 1821. It was one of Cunningham's collections which was used to describe the new Australian genus *Brochosiphon*, with a single species from South Goulbourn Island.

Ferdinand von Mueller published a number of new species of Acanthaceae before the advent of Bentham's "Flora Australiensis" treatment. Among these were new species of *Rostellularia* (Mueller 1852), *Dipteracanthus* (Mueller 1859), *Graptophyllum* (Mueller 1863, 1867), *Dicliptera* (Mueller 1867) and *Justicia* (Mueller 1867). In addition to these, in Bentham's (1868) "Flora Australiensis" treatment, Mueller's work was recognised by the adoption of some of his manuscript names (e.g. *Ruellia primulacea* and *Ruellia corynotheca*).

Bentham's (1868) account of the Acanthaceae of Australia seems to have relied fairly heavily on the work of Mueller and also that of the Scottish botanist Thomas Anderson. Anderson worked in Kew in 1859-60 before returning to the Calcutta Botanic Garden and publishing extensively on African (Anderson 1864) and, more particularly, Indian (Anderson 1867) Acanthaceae. Anderson's wider generic circumscriptions of *Ruellia* and *Justicia* were adopted by Bentham and he also adhered to Anderson's broader concepts of *Nelsonia* (uniting all previous species into one), *Hygrophila salicifolia*, *Ebermaiera glauca* and *Justicia procumbens*. These weedy species had all previously been given separate names in Australia,

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\*Nees was responsible for editing the 2nd edition of Brown's *Prodromus* which is an almost exact copy of the original. This explains his familiarity with Brown's work, although he did see a number of collections from Kew.

Genus	Nees 1847a		Anderson 1864 & 1867		Bentham 1876	Lindau 1895		Bremekamp 1965
<i>Thunbergia</i>	SO	Acanthaceae	SO	Thunbergiaceae	T	Thunbergiaceae	SF	THUNBERGIACEAE
<i>Nelsonia</i>	T	Nelsoniaceae	SO	Ruellieae (Contorted)	T	Nelsoniaceae	SF	Tribe Nelsoniaceae (SCROPHULARIACEAE)
<i>Suaresia</i>	T	Nelsoniaceae	T	Nelsoniaceae	T	Nelsoniaceae	SF	
<i>Ruellia</i>	SO	Echmatanthaceae	T	Ruellieae	T	Ruellieae	SF	
<i>Stephanophysum</i>	T	Ruellieae	ST	Ruellieae	ST	Ruellieae	T	
<i>Dipteracanthus</i>	T	Ruellieae	ST	Ruellieae (as <i>Ruellia</i> )	ST	Ruellieae (as <i>Ruellia</i> )	T	
<i>Brunoniella</i>	T	Ruellieae	ST	Ruellieae (as <i>Ruellia</i> )	ST	Ruellieae (as <i>Ruellia</i> )	ST	
<i>Hemigraphis</i>	T	Ruellieae	ST	Strobilantheae	ST	Strobilantheae	ST	
<i>Hygrophila</i>	T	Hygrophilaceae	ST	Hygrophilaceae	ST	Hygrophilaceae	ST	
<i>Acanthus</i>	T	Acanthaceae	SO	Acanthaceae (Imbricate)	T	Acanthaceae	SF	
<i>Barleria</i>	T	Barleriaceae	T	Barleriaceae	T	Barleriaceae	SF	
<i>Lepidagathis</i>	T	Barleriaceae	T	Barleriaceae	T	Barleriaceae	T	
<i>Andrographis</i>	T	Andrographideae	T	Andrographideae	ST	Andrographideae	T	
<i>Asystasia</i>	T	Ruellieae	ST	Asystasiaceae	ST	Asystasiaceae	T	
<i>Pseudanthemum</i>	T	Eranthemaceae	ST	Eranthemaceae	ST	Eranthemaceae	T	
<i>Gratiophyllum</i>	T	Gendarrussaceae	ST	Justicieae	ST	Justicieae	T	
<i>Xeranthemella</i>	—	—	—	Gratiophyllaceae	—	—	—	
<i>Dicladanthera</i>	—	—	—	—	—	—	—	
<i>Dicliptera</i>	T	Dicliptereae	ST	Dicliptereae	ST	Dicliptereae	ST	
<i>Peristrophe</i>	T	Dicliptereae	ST	Dicliptereae	ST	Dicliptereae	ST	
<i>Hypoxis</i>	T	Dicliptereae	ST	Dicliptereae	ST	Dicliptereae	ST	
<i>Isoglossa</i>	—	—	—	—	—	—	—	
<i>Rhaphidospora</i>	T	Dicliptereae	ST	Justicieae (as <i>Justicia</i> )	ST	Justicieae (as <i>Justicia</i> )	ST	
<i>Calophanoides</i>	—	—	—	—	—	—	—	
<i>Rostellularia</i>	T	Gendarrussaceae	ST	Justicieae (as <i>Justicia</i> )	ST	Justicieae (as <i>Justicia</i> )	T	
<i>Sarajusticia</i>	—	—	—	—	—	—	—	
<i>Anisostachya</i>	T	Gendarrussaceae	ST	Justicieae	ST	Justicieae	T	

Table 1: History of the major subdivisions of Acanthaceae and the position of the Australian genera within these divisions.  
T = tribe, ST = subtribe, SO = "suborder", SF = subfamily; all endings are as quoted by the original author.

\* = *Isoglossinae*

but Anderson considered them as single species widespread and variable from India through to Australia. Bentham was responsible for the first attempts to split the two species complexes, *Hypoestes floribunda* and *Eranthemum* (= *Pseuderanthemum*) *variable*, into infraspecific categories.

After the "Flora Australiensis" was published, Mueller described a number of new species in *Thunbergia* (Mueller 1875, 1882a), *Strobilanthes* (Mueller 1882b), *Justicia* (Mueller 1882d), and *Hypoestes* (Mueller 1891) as well as his new genus *Dicladanthera* (Mueller 1882c). F.M. Bailey's (1901) accounts of the Acanthaceae of Queensland mainly reiterated Bentham's work, the only species newly recorded for Australia being *Asystasia australasica*, described from Thursday Island, and the two Indian species *Rungia latior* and *Justicia notha*.

Domin's (1929) consideration of Acanthaceae, which followed his visit to Australia in 1910, provided little in the way of new species, but led to major restructuring of the genera *Pseuderanthemum* and *Justicia*, mostly at an infraspecific level. However, the large number of species and varieties he recognised, with the exception of *Justicia glaucoviolacea* and *J. clementii*, seem to have been largely ignored in later floras.

The Queensland botanist, C.T. White (1944), was responsible for adding a new monotypic genus, *Xerothamnella*, to the Australian record. He was also the author of a new species of *Graptophyllum* (1939).

C.E.B. Bremekamp's many early publications on Malaysian Acanthaceae, particularly that of 1948, are often relevant to Australian taxonomy, but it was not until his works of 1962 and 1964 that he actually commented on Australian specimens. Bremekamp described two new genera, *Sarojusticia*, a segregate of *Justicia*, and *Brunoniella*, a segregate of *Ruellia*. He also advocated the use of *Rostellularia pogonanthera* for Australian material previously called *Justicia procumbens*, *Nelsonia campestris* instead of *N. canescens*, *Thunbergia arnhemica* for the native *Thunbergia* instead of *T. fragrans*, and he described a new species and variety of *Dipteracanthus*. The majority of these recommendations have been adopted in subsequent Australian flora treatments and censuses, the only exception to this being the reduction to synonymy of his new taxa in *Dipteracanthus* by W.R. Barker (1981).

## Subdivisions of the Acanthaceae and placement of Australian genera

### A. HISTORY OF SUBDIVISIONS OF ACANTHACEAE

Table 1 shows the changes of interpretation that have occurred in the major subdivisions of Acanthaceae. Only genera occurring in Australia have been included.

The first person to subdivide the family, Nees von Esenbeck (1847a), recognised two suborders depending on the presence or absence of retinacula (seed-bearing hooks) in the capsule; within these suborders there were 11 tribes primarily grouped on calyx, corolla, stamen and capsule morphology. With the exception of *Asystasia* in tribe Ruellieae and his large tribe Gendarusseae which has not been recognized by subsequent authors, most of the genera occupy similar positions to those found in more modern treatments.

Anderson (1864, 1867) split Acanthaceae into three suborders, the Thunbergideae containing only *Thunbergia*, Ruellideae which consisted of all the genera with contorted corolla lobes in bud and Acanthideae in which the genera all had imbricate corolla lobes. Within the last two suborders, tribes and subtribes were recognised. As well as the change in rank compared to Nees's classification, where only the tribal level was used, the Nelsonieae were treated as a tribe of the Ruellideae, *Asystasia* was transferred to its own tribe within the Acanthideae and the tribes Gendarusseae and Dicliptereae were in the main amalgamated to form the tribe Justicieae with a number of subtribes.

Bentham (1876) further reduced the number of tribes to a total of five, with the Thunbergiaceae once again being reduced to tribal level, the Ruellieae, Nelsonieae and Acantheae remaining mostly unchanged, but the tribe Justicieae being expanded to encompass the previously recognised tribes of Barlerieae, Andrographideae and Asystasieae at subtribe level. Apart from the reduction in rank of some tribes to subtribes, Bentham's subdivision was similar to Anderson's.

Lindau (1895) extended Radlkofer's (1883) earlier wide survey of the pollen morphology of Acanthaceae and, based predominantly on this, again increased the number of tribes considerably. He recognised the subfamilies Thunbergioideae, Nelsonioideae and, outside Australia, Mendoncioideae, for the first time, while the rest of the family was placed in his subfamily Acanthoideae. This was further split into 2 groups without rank, but often referred to as series (Leonard 1951), the Contortae and the Imbricatae, the first consisting of seven tribes and the second of 9 tribes and 5 subtribes. New tribes to be described were the Pseuderanthemeae, Odontonemeae and the Isoglosseae, all of which had been treated by Bentham under Justicieae.

Bremekamp's (1965) subdivision of Acanthaceae, split off two families, the Thunbergiaceae and Mendonciaceae, and introduced the possibility of the Nelsonieae being a tribe of Scrophulariaceae. In the rest of the family he recognised two subfamilies, Acanthoideae and Ruellioideae. The former had 5 tribes, of which the only Australian representative is Acantheae. The much larger subfamily Ruellioideae consisted of 7 tribes, with three of these, Ruellieae, Lepidagathideae and Justicieae, having several subtribes. As with Lindau's classification the tribes and subtribes were split largely on pollen morphology, although Bremekamp did use other supporting characters. Within his tribe Justicieae there were a number of genera of uncertain position and he was not satisfied with his subdivision of the tribe at that time.

## B. PLACEMENT OF AUSTRALIAN GENERA

Table 2 lists the genera of Acanthaceae occurring in Australia and recognised in this work with their tribal, subtribal and subfamily status. The placements are largely based on Bremekamp (1966). Strong arguments have been presented, particularly by Bremekamp (1953, 1965), for the removal of subfamily Thunbergioideae to a family of its own, and for removal of the Nelsonioideae to an uncertain position, either within Scrophulariaceae or perhaps within a new segregate family of the Scrophulariaceae, the Rhinanthaceae. A comparison of subfamily characteristics is given in Table 3. By removing these two subfamilies the Acanthaceae (*sensu stricto*), at least in Australia, would become a more natural group and would then be easily recognised by their 2 or more superposed ovules per cell, their flattened seeds (except in *Andrographis* where they are not distinctly flattened) and their loculicidal, often elastically opening, capsules with retinacula (or hooks) at the base of the seed. In addition, all the genera of Acanthaceae *sensu stricto* in Australia, except *Acanthus*, would possess cystoliths (usually in the form of white, linear curved streaks, more rarely dot-like: see morphology) at least on the leaves, but often extending onto the stems and petioles. Thunbergiaceae would be recognisable by its collateral ovules, excavated seed, beaked capsule and unusual calyx structure.

Despite these considerations the expanded concept of Acanthaceae receives wide acceptance and, in view also of the regional nature of this work, is the one adhered to here. Warning is given that in the majority of family keys, the genera here treated under subfamily Nelsonioideae usually key out under Scrophulariaceae. In Clifford's (1981) key to the Australian families, *Staurogyne* keys out to Acanthaceae, but *Nelsonia* comes out under Scrophulariaceae.

Hossain (1972), who reviewed the whole of this group, recommended the Nelsonioideae be reduced to tribal level within the Acanthaceae, although I am not aware that his reasons for this have been published.

Subfamily Thunbergioideae	1. <i>Thunbergia</i>
Subfamily Nelsonioideae	2. <i>Nelsonia</i> 3. <i>Staurogyne</i>
Subfamily Acanthoideae	4. <i>Acanthus</i>
Subfamily Ruellioideae	
Tribe Ruellicae	
Subtribe Ruelliinae	5. <i>*Ruellia</i> 6. <i>*Stephanophysum</i>
	7. <i>Dipteracanthus</i> 8. <i>Brunoniella</i>
Subtribe Strobilanthinae	9. <i>Hemigraphis</i>
Subtribe Hygrophilinae	10. <i>Hygrophila</i>
Subtribe Barleriinae	11. <i>*Barleria</i>
Tribe Lepidagathideae	12. <i>Lepidagathis</i>
Tribe Andrographideae	13. <i>*Andrographis</i>
Tribe Justicieae	
Subtribe Odontoneminae	14. <i>Asystasia</i>
	15. <i>Pseuderanthemum</i>
	16. <i>Graptophyllum</i>
Subtribe Uncertain	17. <i>Xerothamnella</i>
	18. <i>Dicladanthera</i>
Subtribe Diclipterinae	19. <i>Dicliptera</i>
	20. <i>Peristrophe</i>
	21. <i>Hypoestes</i>
Subtribe Isoglossinae	22. <i>Isoglossa</i>
Subtribe Justiciinae	23. <i>Rhaphidospora</i> 24. <i>Calophanoides</i>
	25. <i>Sarojusticia</i> 26. <i>Rostellularia</i>
	27. <i>*Anisostachya</i> 28. <i>*Justicia</i> s. lat.

Table 2: Placement of Australian genera in the family.

Apart from not splitting off the Thunbergioideae or the Nelsonioideae the placement of the Australian genera is the same as that advocated by Bremekamp (l.c.), except the inclusion of the genera 19-21 within the subtribe Diclipterinae and genera 17-18, which have not been assigned to a subtribe. All of these genera, with the exception of *Xerothamnella* which was unknown at the time, were placed by Lindau (1895) in his tribe Odontonemeae and so they should, according to Bremekamp, belong to the subtribe Odontoneminae.

However, Bremekamp lists the characters of Odontoneminae as being the corolla without a rugula, either four stamens or two stamens and two staminodes, 2-celled anthers, with the cells inserted at the same height, or rarely, 1-celled anthers, and pollen grains provided with colpoid streaks. From a brief look at the pollen it would appear that all five genera agree with the subtribe character, but in all macromorphological respects they disagree with subtribe Odontoneminae. Instead the generic characters agree with the subtribe Isoglossinae which according to Bremekamp has "two stamens not accompanied by staminodes" and "bitheous anthers of which the thecae are inserted at unequal height". The pollen type is said to be lenticular and 2-porous. On pollen type the subtribe Isoglossinae is not the correct place for them. There seem to be good arguments for recognising a subtribe Diclipterinae as has been advocated in all of the earlier subdivisions (see Table 1) to encompass the genera *Dicliptera*, *Hypoestes* and *Peristrophe*. This does not solve the position of the Australian endemics, *Xerothamnella* and *Dicladanthera*, and with further investigations of their relationships it may prove necessary to give them separate subtribal rank.

Subfam.	cystoliths	nodes	bracts	calyx	stamens	anthers	pollen	ovules	capsule	hooks	seeds	seed no.	endosperm
Timbergioidae	absent	not jointed	opposite	entire ring or unequally 5-16 toothed	4	2-celled with meandering fissures, or flat with folded margins	globose	collateral	beaked	absent	semi-globose exacavated	2-4	absent
Nelsonioidae	absent	not jointed	apically alternate	4-5- partite	2 or 4	2-celled globose or ellipsoid 3-colpate	2(-4) rows	not beaked	absent	globose		4-60	present
Acanthoidae	absent	not jointed	opposite	4-5- partite	4	1-celled colpate	superposed in 2 rows	not beaked	present	discoid		4-8	absent
Ruellioideae	present	jointed	opposite	4-5- partite	2 or 4	at least 2 of them 2-celled, except <i>Hypocistis</i>	porate or superposed in 2 rows	not beaked	present	discoid except <i>Andro- graphis</i>		2-24	absent

Table 3: Comparison of characteristics of the four subfamilies of Acanthaceae represented in Australia — pollen and endosperm data based on Bremekamp 1955.

Some difficulty was encountered in separation of the tribe Lepidagathideae from tribe Ruellieae subtribe Barleriinae. As will be seen in the key to classification of the family these two tribes seem to be closer than Bremekamp's subdivision would suggest and earlier classifications (Table 1), where they were placed within the same tribe or subtribe, seem more realistic. This suggestion was also supported by the pollen studies of Raj (1961) where he stated that a superficial resemblance between the pollen of *Ruellia* and *Barleria* was not indicative of a close relationship, but rather that *Barleria* and *Lepidagathis* show a close affinity by their sporoderm stratification.

The alternative to basing the classification of the Australian Acanthaceae largely on Bremekamp's work was to adopt that of Lindau (1895). However, from Table 1 it will be seen that practically every genus represented in Australia would then belong in a different tribe. It was felt that such a system did not accurately reflect relationships between Australian genera. Thus, while the subdivision of tribe Justiceae by Bremekamp is not satisfactory (which Bremekamp admitted) it does give an idea of generic relationships in Australia.

It seems likely that the classifications of both Bremekamp and Lindau relied too heavily on pollen characteristics, the earlier classifications by Anderson and Bentham in particular being more realistic and relying on macromorphological characters, (Table 1). With a revision of genera in Australia, only an unrepresentative sample of the total number (c. 250 genera) has been seen and this makes further comment inappropriate.

### Relationships of the Australian genera

The majority of genera recorded for Australia are extensions of the ranges of the same genera from India and Malesia. These extensions of range into Australia are frequently represented by different species from those in Malesia, but in some cases a revision of the genus concerned may indicate that this specific status is not warranted. This may prove to be so with *Hygrophila*, *Nelsonia*, *Rostellularia* and *Hypoestes*. Some of the Australian species are shared with the southern part of New Guinea, and include species of *Staurogyne*, *Dipteracanthus*, *Brunoniella*, *Graptophyllum*, *Hypoestes*, *Pseuderanthemum* and possibly *Asystasia*, *Lepidagathis* and *Hemigraphis*, for all of which I have seen conspecific New Guinea material. The New Guinea species of Acanthaceae are not well documented taxonomically.

Of the four genera endemic to Australia, *Brunoniella* and *Sarojusticia* are segregates of the *Ruellia* and *Justicia* generic complexes respectively (see discussion of these before the key to the genera). *Xerothamnella* and *Dicladanthera* are related to each other, but are of somewhat uncertain position in the family.

*Brunoniella*, while obviously part of the world-wide *Ruellia* sensu lato complex, is most closely related to the genera *Pararuellia* Bremekamp (5 Malesian species) and *Leptosiphonium* F. Muell. (10 New Guinea species). Whether all three deserve generic status awaits a revision.

The arid-zone genus, *Sarojusticia*, seems to be most closely related to the only Australian species of *Calophanoides* from the rainforests of eastern Australia. There may be reason in the future to combine the two genera with better knowledge of *Calophanoides* and its relationship to Malesian taxa. The two disjunct subspecies of *S. kempeana* (Fig. 41), one from the MacDonnell Ranges in central Australia and the other from the Murchison-Gascoyne regions of Western Australia may be relicts of a more widespread distribution.

*Xerothamnella* from Queensland and *Dicladanthera* from Western Australia are different in many respects, but the two are more closely related to each other than to any other genus in Australia as shown by their anther arrangement and inflorescence structure. Their unique anther arrangement may indicate a common ancestry, but similar arrangements are found in some *Justicia* species of America. The two genera are probably ancient relicts.

### Distribution of the family in Australia

Australian genera of Acanthaceae are restricted to what has generally been called the tropical region of Australia (e.g. Burbidge 1960), roughly equivalent to the megatherm seasonal (or Torresian zone) of Nix (1982). It is noteworthy that Nix's megatherm seasonal zone extends well to the south of Burbidge's tropical zone along the east coast of Australia, a pattern duplicated by the range of the genus *Brunoniella*. Some genera, for example *Dicliptera* and *Hypoestes*, also extend into the interzone area between the tropical (Torresian) and the arid (Eyrean) zones, while others like *Dipteracanthus* and *Rostellularia* extend from the Torresian to the arid Eyrean, with *Rostellularia*, by its occurrence in the Flinders Ranges of South Australia, also represented in the interzone between the arid (Eyrean) and temperate (Bassian or mesotherm seasonal) zones. The Australian species of *Hypoestes* and *Rostellularia* are both widespread and polymorphic, with variation predominantly reflecting differing ecological conditions.

The two genera *Hemigraphis* and *Lepidagathis*, newly recorded from Australia from the McIlwraith and Iron Ranges of Cape York Peninsula, occur in areas which according to Nix (l.c.) have their closest bioclimatic affinities with parts of southern lowland New Guinea. The Australian material of both genera is almost certainly conspecific with New Guinea material, as is the *Asystasia* species recorded only from the Torres Strait Islands.

There are two genera, *Xerothamnella* and *Rhaphidospora*, with a single species in the arid (Eyrean) zone and another in the megatherm seasonal (Torresian) zone. In both cases the vicariant species are very distinct. As already discussed this pattern of distribution probably exists with the species presently designated as *Sarojusticia* and *Calophanoides*. If *Sarojusticia* is congeneric with *Calophanoides*, *Di cladanthera* would be the only genus wholly confined to the arid region.

### Morphology

#### A. CHARACTERS OF TAXONOMIC IMPORTANCE IN AUSTRALIA

The morphology of the Australian species of Acanthaceae is discussed with reference to those characteristics which have been used to separate taxa, and in relation to the infra-familial classification of the family shown in Table 1. A short review of chromosome numbers has been included even though no work has been carried out on Australian material. The functional significance of characters is discussed where this is apparent, although those characters which are concerned with the floral biology and hence involve several organs, are dealt with in a separate section.

#### 1. Habit and life-span

The only climbers or twiners in Australia are the members of the genus *Thunbergia*. Of the other genera, *Nelsonia* forms a prostrate, creeping mat, usually with ascending floral branches, while *Brunoniella* has a number of species which form basal rosettes. For the rest, the family consists of erect or decumbent herbs which may become quite large in the wetter areas, while there is a tendency towards small, woody, often intricately branched and sometimes spiny, shrubs in more arid areas (e.g. *Rhaphidospora bonneyana*, *Xerothamnella parvifolia*). Exceptions include *Graptophyllum* species from eastern Queensland which are usually shrubby, but are sometimes recorded as small trees, the mangrove genus, *Acanthus*, which is also a small shrub, and some of the varieties of *Hypoestes* from the western part of its range which can become shrubby. A number of the smaller herbs are presumably annuals or short-lived perennials, with, as for example in *Brunoniella*, aerial parts produced seasonally from a perennial rootstock.



## 2. Root system

Very little is known about the root system of acanthaceous plants in Australia with the exception of the subtribe Ruelliinae where the roots are usually tuberous. Although the tubers are only slender, in one species (*Brunoniella acaulis*) they have been recorded as used by the aborigines as a food source. In the introduced species, *Ruellia tuberosa*, the tuberous root system is possibly part of the reason why it has become so successfully established in waste places in the Darwin area. The cultivated *Acanthus* cf. *mollis* of subfamily Acanthoideae which has become naturalised in South Australia and probably in other states as well, also has large tuberous roots which have aided its dispersal.

Some of the species which occur in wetter areas, e.g. *Hygrophila*, *Nelsonia* and *Staurogyne*, form roots at least at the lower nodes.

## 3. Cystoliths

Cystoliths are present in the leaves, and often the stems, petioles and bracts of all Australian Acanthaceae, with the exception of the four genera belonging to subfamilies Thunbergioideae, Nelsonioideae and Acanthoideae. In fresh material they can be best detected in the leaves with use of a hand lens and transmitted sunlight when they appear as white streaks. In dried material they occur as white or sometimes dark elevations or streaks and vary from dot-like to the more usual linear or boomerang-shaped.

Although they are not confined solely to Acanthaceae, none of the other closely related families possess cystoliths so that their presence is often an easy identification tool for isolating Acanthaceae. Other families having cystoliths include Cannabaceae, Moraceae and Urticaceae.

There is some controversy concerning the use of the term cystolith. Other terms used by earlier authors to describe the structures in the Acanthaceae include "leaves lineolate" or leaves with "rhapids". Anatomically however cystoliths and rhapids are quite distinct (Screemadhavan et al, 1968), the first being an outgrowth of the epidermal cellulose cell wall impregnated with calcium carbonate and the second being aggregates of long calcium oxalate crystals in large cells which are dead at maturity and often filled with mucilage. Because of this difference and that cystoliths and rhapids can only be anatomically differentiated in cleared leaves, Sreemadhavan et al (l.c.) advocated the use of the general term "furuncle" by plant taxonomists, but this appears not to have been widely adopted.

A number of authors (Lindau 1895, Metcalfe & Chalk 1950) have recognized several different cystolith types within Acanthaceae:

- double cystoliths: *Barleria* —
- solitary, round: *Asystasia*, *Andrographis*, *Pseuderanthemum* —
- solitary, elongated, both ends blunt: *Graptophyllum*, *Lepidagathis* —
- solitary, elongated, one end pointed: *Ruellia* —
- solitary, elongated, both ends pointed: *Rostellularia*

Occasionally cystoliths have been diagnostically important in this study. At the generic level *Asystasia* and *Pseuderanthemum* are closely related and sometimes confused in Australia and New Guinea, particularly when flowers are lacking; *Asystasia* possesses dot-like cystoliths while those of *Pseuderanthemum* are more elongated and often with one end pointed.

The genus *Acanthus* lacks cystoliths although there appear to be white streaks resembling them on the leaves and capsules of the mangrove species. These are the salt-secreting glands. The lack of cystoliths in *Nelsonia* and *Staurogyne* is diagnostic within the Acanthaceae, but this negative character, coupled with the lack of other characteristics (e.g. seed-bearing hooks, compressed seeds) means that it is often difficult to recognise the genera at family level.

Cystoliths have been used below the genus level in Australia only in the case of infraspecific taxa of *Rostellularia adscendens*, where the size and orientation of cystoliths in the leaves is frequently diagnostic.

#### 4. Stems and branches

Branching is decussate with the areas just above the nodes frequently constricted and the nodes themselves often articulate or jointed, such that each leaf of an opposite pair is joined by a transverse ridge.

As with the Labiatae the stems and branches of the Australian Acanthaceae are frequently 4 or 6-angled. This is particularly characteristic of the subfamily Ruellioideae, and less prominently, *Thunbergia* (Thunbergioideae). It is easily seen in plants which remain herbaceous, but in those which become woody the angles are seen in the younger herbaceous branches. By contrast, the stems are terete in subfamilies Nelsonioideae and Acanthoideae.

Angled stems are frequently longitudinally grooved or possess longitudinal lines of sparse to dense, usually more or less appressed, eglandular hairs. In terete stems the indumentum, when present, is spread evenly.

The nature of the indumentum on the stems is similar to that on the leaves.

#### 5. Leaves

The leaves are decussately arranged in Acanthaceae. Rare exceptions are found in *Nelsonia* and *Staurogyne* of subfamily Nelsonioideae where they become spirally arranged on the upper floral axes (and intergrade into the bracts), or in the few rosette forming species in *Brunoniella* in which the internodes are reduced. Opposite leaf bases are frequently joined by a transverse ridge across the node. Occasionally the pairs are unequal in size, as in *Brunoniella spiciflora* and *Pseuderanthemum tenellum*. The leaves may or may not be petiolate, a characteristic sometimes separating allied species or infraspecific taxa. In *Graptophyllum* the base of the petiole is swollen below the abscission line (Fig. 25). This characteristic seems to be confined to *Graptophyllum* apart from some limited swelling in *Pseuderanthemum* and *Sarojusticia*. The presence of an abscission line at the base of the petiole, often represented by a darker transverse line, is very common in Australian genera (e.g. *Peristrophe*, Fig. 35B); it is sometimes more obvious in species which are glabrous.

Leaves in Australian taxa are always simple, with the blade ovate to linear. Margins are most often entire, although they can become spiny or toothed in species of *Acanthus*, *Graptophyllum* and *Sarojusticia*. Apices range from acute to obtuse, being spine-tipped only in *Barleria* (introduced) and *Acanthus* species.

Indumentum is considered to be of great diagnostic importance. Some genera such as *Acanthus* and *Graptophyllum* may be completely glabrous. *Nelsonia* is densely pubescent all over, while in other genera only the petiole, midrib and main lateral veins are pubescent. Hairs are always simple with the most common type being 3-4-celled and eglandular. On the young leaves of some taxa, e.g. in *Hypoestes* and *Rostellularia*, there is sometimes a dense cover of tiny hairs tipped by inconspicuous glands giving the leaves a velvety appearance; this sometimes persists in adult foliage. The only native genus with obviously glandular hairs is *Staurogyne*, although these hairs do occur in the submerged leaves of the introduced *Hygrophila triflora*. Glaucous leaves are evident in only two taxa, one each in *Rostellularia* and *Hypoestes*.

## 6. Inflorescence

The inflorescences of genera of Acanthaceae are usually complex. They frequently appear to be single flowers, but are often highly condensed inflorescences, often with no obvious rachis. Sell (1969) reviewed the detailed structure of the inflorescence in a number of acanthaceous genera, and it is not my intention to discuss these here except in general terms and as it affects the taxonomy in Australia.

One of the most common inflorescence types is the dense usually terminal spike, i.e. with consecutive bracts and flowers overlapping, or almost so. This is found in *Nelsonia*, *Acanthus*, *Lepidagathis*, *Hemigraphis*, *Rostellularia*, *Anisostachya* and some species of *Barleria*. In *Dicliptera* and *Hypoestes* some of the taxa have the involucre units (composed of fused bracts and containing more than one flower) arranged in a spike-like fashion. The spikes vary in their possession of bracts and bracteoles (defined in the following section), but the usual case is for each flower to be subtended by a single bract and two bracteoles. The bracts within the spike are usually decussately arranged, as in *Rostellularia* and *Lepidagathis*. A loose spike (i.e. the flowers not overlapping) is found in some taxa of *Brunoniella*, *Hypoestes* and depending on the interpretation of the inflorescence in *Sarojusticia* and *Staurogyne*.

The other common inflorescence type is the dense, often sessile, axillary "cluster" found in *Hygrophila*, *Dicliptera*, *Calophanoides* and some taxa of *Hypoestes* and *Barleria*, or the shortly pedicellate cluster found in some *Graptophyllum* species. Although superficially similar in appearance, these can vary considerably in their structure, those of *Dicliptera* and *Hypoestes* for instance being extremely complex since the "cluster" is composed of involucre units (see above). The inflorescences of *Dipteracanthus* and *Brunoniella* are similar to the cluster type, but here the more or less sessile flowers have been reduced to only 1-2 in the axil of each bract such that overall the flower-bearing parts of each main branch appear to be racemose.

*Asystasia* and *Pseuderanthemum* most commonly have flowers arranged in a terminal raceme with the flowers solitary, paired or in opposite cymes along the rachis. Some of the introduced *Thunbergia* species also show this inflorescence type, while in the native *Thunbergia arnhemica* the same inflorescence is elongated such that the flowers appear to be solitary in the axils of the upper leaves.

Leafy panicles are characteristic of the introduced *Andrographis paniculata* and some of the infraspecific taxa of *Hypoestes floribunda* have their involucres arranged in a panicate fashion.

The only other inflorescence type which occurs frequently is the long pedicellate or pedunculate inflorescence arising from the axil and terminated by a single flower (*Brunoniella acaulis*, *Thunbergia arnhemica* (but see above), a cyme (*Ruellia*), this cyme frequently dichotomous (*Isoglossa*, *Rhaphidospora*), or a cluster of flowers (*Dicladanthera*, *Xerothamnella*). The generalized term "cluster" of flowers for *Dicladanthera* and *Xerothamnella* reflects the difficulty in analysing the inflorescence owing to the minuteness of some of the buds present and the limited amount of floral material available.

## 7. Bracts and bracteoles

The use of the terms 'bract' and 'bracteole' within Acanthaceae is by no means consistent in the world literature and is often ambiguous. Inconsistencies between authors are probably best illustrated in *Thunbergia* and genera of subtribe Ruelliinae, *Hygrophila* and *Barleria*. In Malaysian treatments all of these are usually described as having bracteoles, whereas American authors tend to describe them as bracteate and lacking bracteoles. Other problems arise in genera with involucres; in the case of *Hypoestes* they are sometimes referred to as comprising an outer pair of bracts fused to an inner pair of 'bracteoles'. Because the involucre can contain

more than one flower the use of the term 'bracteole' in this case is incorrect and can cause difficulties in interpretation to workers unfamiliar with this structure. The tendency in Malesia seems to have been the recognition of any paired structures on the pedicel below the calyx as 'bracteoles', whereas the definition of a bract as a modified leaf and a bracteole as a secondary bract has mostly prevailed in American usage.

In this work the decision was made to adopt the term bracteole for paired structures below the calyx, while bract is used for the organs, often leaf-like, which subtend a flower. Thus, the usage of the terms here should be consistent with usage in Malesia. The approach which best facilitates interpretation of these structures is to find an individual flower and work down from the calyx, bearing in mind that there are frequently rudimentary flowers present in a number of genera. Paired structures on the pedicel below the calyx are 'bracteoles'. The usually single structure which subtends the pedicel is the bract; it can be small and of similar size to the bracteoles, e.g. *Rostellularia* and *Pseuderanthemum*, or larger and often gradually intergrading into the leaves. In the case of the genera *Ruellia* and *Stephanophysum* and the unnamed *Brunoniella* species, where the inflorescences are dichasial, the same approach has been used. However, not only are the structures of the pedicels of the two lateral flowers referred to as bracteoles, but so are the paired structures at the apex of the peduncle. It is acknowledged that there are equally good arguments for referring to these latter organs as bracts. In the case of *Brunoniella* in particular, where there are a number of different inflorescence types, the paired structures of the dichasia appear to be homologous with the bracteoles of the other inflorescence types found in *Brunoniella* and *Dipteracanthus*. Therefore in this case the descriptions are somewhat different from Bremekamp's (1948) and Backer's (1963) Malesian treatments of *Ruellia* and *Stephanophysum* where the structures are referred to as bracts.

The shape and size of the bracts and bracteoles is frequently of importance at all levels of classification. In many genera, e.g. *Thunbergia*, subtribe Ruelliinae, *Hygrophila*, *Staurogyne* and *Sarojusticia* the leaves and bracts are indistinguishable, except possibly for a decrease in size towards the younger parts of the inflorescence. Thus, leaf characters used in separating taxa are sometimes also evident in the bracts.

The nature of the indumentum is used extensively to distinguish species and infraspecific taxa. It is sometimes similar in composition to that of the upper leaves, although in many cases there are glandular hairs on the bracts and bracteoles although these are nearly always lacking on the leaves. Both of the polymorphic species, *Hypoestes floribunda* and *Rostellularia adscendens*, rely heavily on the nature or absence of hairs, particularly those associated with the bracts, for their separation into infraspecific taxa.

## 8. Calyx

The most common calyx is one of five segments, all acute, equal in size and joined at the base. Departures from this include four of the lobes equal in size and the fifth larger (*Staurogyne*), or smaller (*Rostellularia*, *Anisostachya*), or the situation in *Lepidagathis* where the posterior lobe is the largest, the anterior pair joined for half their length and the lateral pair narrowest.

In *Barleria* and *Acanthus* there are four free segments, but they form an outer and smaller inner pair. In *Nelsonia* there are four calyx segments, the posterior one largest, the two lateral ones narrowest and the anterior of intermediate size and emarginate. A different arrangement is found in *Thunbergia* where the calyx can be an entire ring or, in Australia, 12-20-lobed. In the latter case the lobes are somewhat unequal and obscured by the pair of large bracteoles enveloping the corolla tube; the bracteoles are easily confused with the calyx.

Indumentum of the calyx is of limited importance in terms of its presence or absence. Hairs of similar nature to those on the bracts and bracteoles may occur on the calyx and there are sometimes ciliate hairs along the margins.

## 9. Corolla

### a. Shape

The shape of the corolla is usually generically important. It is most often 5-merous and either more or less regular, or 2-lipped. In the subfamilies Thunbergioideae and Nelsonioideae and the subtribe Ruelliinae (Ruellioideae) all have more or less regular corollas, as can some species of *Asystasia*, *Dicladanthera*, *Pseuderanthemum* and *Barleria*, all of subfamily Ruellioideae. In a number of cases, even where the corolla lobes are equal, these "regular" flowers are in effect 2-lipped by the projection of the abaxial surface past the adaxial. This is discussed further under the floral biology.

In the distinctly 2-lipped corollas, found in subtribes Justiciinae and Diclipteriinae and genera *Lepidagathis* (Lepidagathideae), *Hygrophila* (Hygrophilinae) and *Graptophyllum* (Odontoneminae) all belonging to subfamily Ruellioideae, the upper (adaxial) lip is usually notched or 2-lobed and the lower (abaxial) lip 3-lobed to a varying degree. Variations to this arrangement are found. In the genus *Xerothamnella* the adaxial lip is 4- or 2-lobed and the abaxial 1- or 3-lobed, although within the flowers of one bush the orientation of the lips is frequently reversed. In *X. parvifolia* at least (W.R. Barker, pers. comm. ix.1984) the adaxial and abaxial surfaces are difficult to define. In *Andrographis*, presumably due to the pendent nature of the inflorescence, it is the adaxial lip which is 3-lobed and the abaxial which is entire. In *Dicliptera*, *Hypoestes* and non-Australian *Peristrophe* there is the usual arrangement for 2-lipped corollas, but in their case the corolla tube is twisted through 180°, such that like *Andrographis*, the apparent upper lip is 3-lobed and the lower lip entire or emarginate (Fig. 19, 31, 36). In *Hypoestes* the markings on the upper lip are extremely similar to the barred palate found on the lower lip of many of the *Justicia* s.l. species. The single Australian species of *Peristrophe* differs remarkably from its congeners by having the normal lip orientation due to the lack of twisting of the tube. In *Acanthus* the large and showy flowers completely lack the upper lip.

In the majority of genera the corolla forms a narrow 'tube' at the base and widens into a 'throat' above. The stamens are frequently inserted at the junction of the tube and throat, where the corolla is sometimes noticeably constricted, as in *Lepidagathis* and *Thunbergia*. In some genera, e.g. *Asystasia* and *Dipteracanthus*, the relative lengths of the tube and throat have been useful in separating species. Subtribes Isoglossinae and Justiciinae are separated by the presence (in the latter) or absence of a style channel in the upper lip.

### b. Size

This character has been used in separating a number of taxa at specific and infraspecific level, particularly the infraspecific taxa of *Rostellularia*. Where a total length has been given in a description, the measurement has been made along the upper side of the corolla.

### c. Indumentum

The pubescence of both surfaces of the corolla, both in distribution and type of hair, is often diagnostically important, but usually only at a specific level or lower. In many of the genera the filaments, where they become attached to the corolla tube, are continued as a line of pubescence to the base of the tube. These possibly function as nectar guides.

### d. Colour

Colour has not been used to separate taxa, except as a subsidiary character in the cases of *Xerothamnella*, *Hypoestes*, *Thunbergia* and *Graptophyllum*. It is often an unreliable character as it has been observed in some genera with pink or mauve flowers, that there occur a few plants in a population in which the flowers are pure white, e.g. *Sarojusticia* and *Dicliptera*.

In addition, collectors frequently only record the ground or main coloration and the presence or distribution of coloured striations and blotches is ignored. At this stage it has been impossible to accurately document the incidence of 'spotted' corollas amongst *Pseuderanthemum variabile* specimens from Queensland, the presence of a palate in *Asystasia* and the distribution of colour in *Hypoestes*, *Dicliptera* and *Acanthus* are not well documented. All may ultimately prove important diagnostically.

## 10. Stamens

The stamens provide an array of important characteristics which are diagnostic above and below generic level.

### a. Number and arrangement

In the subfamilies Thunbergioideae, Acanthoideae, the tribes Ruellieae and Lepidagathideae of the Ruellioideae and *Staurogyne* (Nelsonioideae) the stamen number is always four. These four stamens are frequently didynamous, although this is not the case in *Acanthus* and *Staurogyne*. Except in *Hygrophila* and *Acanthus*, they are contained in more or less regular flowers. In each case it is the abaxial pair which is longer and the adaxial the shorter, but they are frequently contained on the adaxial side of the throat, thus effectively making these flowers zygomorphic. In the rest of the subfamily Ruellioideae, apart from *Asystasia*, the stamens number two and are contained in predominantly 2-lipped flowers. In most cases they are inserted on the upper lip immediately adjacent the junction with the lower lip. As expected, this situation is reversed in *Hypoestes* and *Dicliptera* where the corolla tube is twisted through 180°, such that the stamens are attached to the apparent lower lip and dehisce upwards (see below).

### b. Filaments

In those flowers with two stamens the filaments are of equal length, while in flowers with four stamens the filaments can be equal or unequal in length. When they are unequal in length the stamens are usually didynamous and the bases of each pair of abaxial and adaxial stamens are often fused by a membrane.

The pubescence of the filaments is a characteristic used to separate species and infraspecific taxa, e.g. *Peristrophe* and *Hypoestes*, but in *Hemigraphis*, Bremekamp (1944) has used the distribution of hairs on the filaments to define a series. In addition relative length of the abaxial and adaxial filaments has been used in separating species, as in *Asystasia*. Filament length was one of the major characters used by Bremekamp (1955b) in separating species of the *Thunbergia fragrans* s.l. complex and the use of this character is discussed under *T. arnhemica*.

The thick, curved filaments of *Acanthus* are unique in the family; the filaments of the adaxial pair of stamens are more curved, allowing the anthers of all the filaments to become appressed to each other.

### c. Connective

In stamens where the anther cells are inserted equally the connective is sometimes extended shortly past the cells at the apex, but this is not of diagnostic use in the Australian Acanthaceae. Whether or not the connective is extended is apparently an unreliable character in both *Thunbergia* and *Brunoniella* where this characteristic has been observed.

The unusual extended connectives of *Xerothamnella* (Fig. 28) and *Dicladanthera* (Fig. 30) are important at the generic and species level. In those genera with unequally inserted anthers the connective is frequently oblique, but this characteristic has not been used here.

#### d. *Anther cell number*

The most common anther cell number is two. The exceptions are *Acanthus* and *Hypoestes* where the number reduces to one, and cleistogamous flowers of *Pseuderanthemum variabile* where the anther cell number is also reduced to one. In *Xerothamnella parvifolia*, there is also one anther cell although in this case the remnant of the second cell is often present.

#### e. *Anther cell shape*

Anther cells are almost always elliptic in shape with longitudinal sutures. Exceptions to this are the globose anther cells of *Nelsonia*, apparently opening by a basal flap, and the apical cell of *Xerothamnella* which opens transversely. Within *Dicliptera*, the two non-endemic species have much shorter and more globular anther cells than the endemic species and this characteristic has been used to separate them.

#### f. *Anther cell arrangement*

The two cells are inserted at the same level or are displaced ('unequally inserted') on the filament. The former is the most commonly encountered, occurring throughout the family with the exception of subtribes Diclipterinae and Justiciinae, where the cells are unequally inserted.

The anther arrangements in *Dicladanthera* and *Xerothamnella* are unique with the former having anther cells at the ends of two perpendicular arms (connective) at the apex of the filament (Fig. 30) and the latter having a terminal, transverse cell and a lower parallel cell or remnant (Fig. 28). These arrangements are more pronounced than those depicted in American species (cf. Fig. 5m, n in Long 1970) and Brazilian species (cf. Fig. 107 in Lindau 1895) of *Justicia* s.l., but the similarity is sufficient to suggest that the relationships of *Xerothamnella* and *Dicladanthera* could lie with American rather than Malesian or African Acanthaceae.

#### g. *Anther cell sutures*

In practically all cases the stamens are held towards the adaxial side of the flower so that the anther cells open downwards and pollen is deposited on the back or the head of any visitor. There are three exceptions in the genera *Hypoestes*, *Dicliptera* and *Andrographis*, where the sutures are reversed and the anther cells open upwards, i.e. towards the upper lip. Similarly in the *Dicladanthera* flower the stamens are held on the opposite side of the regular flower to the stigma and the sutures of the anthers also point upward. This is discussed further under floral biology.

#### h. *Appendages*

These usually take the form of a basal awn (in other works called a spur) or a shorter mucro. *Thunbergia* species, particularly the introduced ones, are frequently long-awned at the base, while in the majority of subtribe Justiciinae (excluding only *Justicia carthaginensis*), the lower anther cell has a long, white basal appendage. In *Asystasia*, *Staurogyne* and *Ruellia* the anthers are often shortly awned or mucronate at the base. These appendages all presumably aid in the transfer of pollen to a visiting insect's back.

#### i. *Indumentum*

Hairs on the anthers are particularly noticeable in *Acanthus* species (Fig. 1C, D, G, H) where often both the sutures and the anther backs are densely covered by long white hairs which contrast with the purplish anther cells. In introduced *Thunbergia* species the sutures of the anthers are frequently pubescent for their whole length.

A number of genera have eglandular hairs on the back of the anther cells, i.e. the opposite surface to that with the suture, although these are not so noticeable as in the preceding genera. These include *Staurogyne*, *Ruellia*, *Asystasia* and all of the Australian genera of the subtribe Justiciinae except *Anisostachya* and *Isoglossa*. In this work the consistent presence of hairs on the anther backs has been used as the basis for recognition of a separate Australian species of *Rostellularia*. A much more noticeable tuft of long eglandular hairs is found on the base of the anther cells of *Andrographis paniculata*.

Glandular hairs and glands are found on the anther backs of some *Acanthus* species and in *Stephanophyllum*.

#### j. Pollen morphology

This characteristic has been used in the past, often extensively, (Lindau 1895, Bremekamp 1965) at the higher levels of classification of the family. In Australia it has been found unnecessary to use it in separating taxa, but it may prove useful in determining relationships, particularly of genera. For instance, the genera *Xerothamnella* and *Dicladanthera* have in this revision been unplaced. The peculiar anther structure of the two genera suggest separation as a subtribe may be warranted if their pollen should prove to be distinctive.

Pollen morphology in *Justicia* s.l. has been surveyed by V. Graham (pers. comm. 1985) and it may prove useful in clarifying the status of the segregate genera which have been recognised here. For instance, Immelman (1983) found that South African species of *Justicia* could be split into two groups, those with terminal spikes having pollen which is 3-colporate and those with axillary inflorescences having pollen which is 2-colporate. However, the 25 African species covered in this treatment comprise only a small part of the estimated 600 total species.

Time has not permitted anything but a brief look at the pollen of the Australian taxa, a situation which can hopefully be rectified at a later date.

### 11. Ovary

The ovary in Acanthaceae is always sessile, 2-celled, superior and usually seated on a nectariferous disc. The number of ovules and their position in each cell varies. The usual situation is two superposed ovules on axile placentas, found in *Acanthus* and the tribes Justicieae and Lepidagathideae, while 4-10 superposed ovules occur in the tribes Ruellieae and Andrographideae. In the subfamily Thunbergioideae the two ovules are collateral in each cell, while in the subfamily Nelsonioideae there are usually many ovules (up to 30 in *Staurogyne*) in two rows in each cell. In these last two subfamilies the seed-bearing hooks are lacking from the base of the ovules. Such hooks are discernible in the ovary in genera which possess them; they are discussed further under the section on the capsule.

### 12. Style

The style is usually of similar length to the stamens or slightly longer. The presence or absence of hairs on the style is often diagnostic as in *Hypoestes* and *Peristrophe*. The length of style has also been used diagnostically, but while it is often a reflection of more obvious flower size differences, e.g. *Dipteracanthus*, *Rostellularia*, it may also indicate differences in the breeding system as, for example, in the case of chasmogamous and cleistogamous flowers which may occur within the same taxon and frequently on the same plant. Accordingly, the presence of very short styles persisting at the apex of mature capsules can sometimes be taken as a guide to cleistogamy, as in *Pseuderanthemum*, *Dicliptera*, *Ruellia* and possibly *Graptophyllum*.



### 13. Stigma

The stigma is most often 2-partite, 2-lobed or simple with a groove. In some genera, particularly those of the subtribe Ruelliinae, the two lobes are often unequal. Frequently in this case one of the lobes is only rudimentary and the other large and flattened. In the case of *Brunoniella* the large flattened lobe is pubescent. In *Barleria* (subtribe Barleriinae) and *Andrographis* (subtribe Andrographideae), the stigmas can be entire, while the cup-shaped stigma of *Thunbergia* (Thunbergioideae) (Fig. 1L) is unique in the family.

### 14. Capsules

Along with corolla and stamen morphology, the capsule characteristics are probably the most important in separating genera of Acanthaceae. Not only is capsule shape important but so is the number of seeds and, where present, seed-bearing hooks (retinacula) and the mechanism of dehiscence. At a specific or infraspecific level of classification, the indumentum on the outer surface of the capsule is often diagnostic.

#### a. Capsule shape, seed position and number

The capsule shape of the majority of Australian Acanthaceae is associated with the number and position of the seeds. The most frequently encountered capsule is club-shaped, with the lower half narrow and seedless and the upper expanded portion seed-bearing. This is the case in all representatives of tribe Justicieae, apart from *Dicliptera* (see below). In all cases, each capsule half has two superposed seeds, these being held in place by conspicuous hooks at their bases. This capsule shape is also found in *Dipteracanthus* and *Stephanophysum* of subtribe Ruelliinae, but here the number of seeds per valve is increased to 4-8 and the stimulus for the capsule to open is frequently different (see below).

In *Barleria* (subtribe Barleriinae), *Lepidagathis* (tribe Lepidagathideae) and *Nelsonia* (subfamily Nelsonioideae) there is a reversal of this shape, with the basal portion of the capsule expanded with seed and the upper portion narrower and lacking seeds. In the first two genera the capsules are 1-4-seeded with seeds held in place by conspicuous hooks, but in *Nelsonia* there are approximately 28 seeds, all lacking hooks at their bases.

The other capsule shape most commonly encountered is a narrow compressed cylinder with an acute or obtuse apex. In all cases there are seeds throughout. This type of capsule occurs in the tribes Ruellieae and Andrographideae in *Ruellia*, *Brunoniella*, *Hemigraphis*, *Hygrophila* and *Andrographis* where it is usually 8-20-seeded, each seed with a hook at its base; in *Staurogyne* (Nelsonioideae) which is up to 60-seeded, the seeds are without hooks at their base (see below).

Different capsule types are found in the genera *Thunbergia* (Thunbergioideae), *Acanthus* (Acanthoideae) and *Dicliptera* (Diclipterinae). In the first there is a large, transversely-ellipsoid base containing the seeds and a long, seedless apical beak (Fig. 1M). In *Dicliptera* (Fig. 31C, D) the capsule is lens-shaped with a thickened rim and a slight apical beak. In *Acanthus* the capsule is similar in shape to that of *Ruellia* (see above), but it is much larger, hardly compressed and there are only one or two seeds per valve.

As indicated above, the seed number can be diagnostically useful. Within tribe Justicieae the number of seeds per capsule is almost invariably 4, with occasional reductions to 2, but in this latter case there is usually a remnant of the hooks and undeveloped ovules present. *Lepidagathis* (Lepidagathideae), *Acanthus* (Acanthoideae), *Barleria* (Barleriinae) and *Thunbergia* (Thunbergioideae) also have 2-4 seeds per capsule.

All other genera have 8-20 seeds per capsule with the exception of subfamily Nelsonioideae where the seed number is larger.

### b. *Seed-bearing hooks*

The peculiar hook-like outgrowths at the base of the seeds have sometimes been called 'jaculators', from the Latin for thrower, or *retinacula*, a derivative of *retineo*, to detain. As their role seems to be largely a passive one, holding the seeds in place ready for dispersal when the capsule opens, the latter term seems more appropriate. If the capsule opens explosively as it does in a number of acanthaceous genera, the seeds are usually flung out some distance and presumably the hooks are responsible for holding the seeds in the best place to facilitate this. Sell (1969b) documents some movement of the hooks on opening of the capsule and so it is possible that the distance the seeds are dispersed is partly due to this. In view of the uncertainty concerning the function of these structures it was decided to use the descriptive term 'seed-bearing hooks'.

Within this treatment only presence or absence of seed-bearing hooks has been used diagnostically at the subfamily level. They are lacking from the Nelsonioideae and Thunbergioideae, but are found in all other representatives of the family. These hooks provide instantaneous recognition of the family Acanthaceae. They may vary somewhat in shape. Those of *Andrographis* (Fig. 19J) have a central swelling and those of *Dicliptera* (Fig. 31D) are very broad. The number of hooks in capsules is identical to the seed and ovule number. Even in those capsules where not all of the ovules develop into seeds, there are remnants of the hooks and ovules. The number of hooks is extremely useful as a guide to seed number since the drying process frequently causes seed to be lost (see below).

### c. *Indumentum*

At a specific, or more commonly an infraspecific level, the indumentum on the outside of the capsule is frequently diagnostic. In *Dicliptera* and *Di cladanthera* this characteristic is used in separating species, while in *Hypoestes* and *Rostellularia* it is used to distinguish infraspecific taxa. The indumentum, if present, is usually confined to the seed bearing portion of the capsule. Hairs may be eglandular, or conspicuously glandular, or a mixture of the two.

### d. *Mechanism of dehiscence*

Mature capsules of Acanthaceae frequently open explosively, but with only herbarium material available it has been difficult to complete a survey of those genera which do. The process of drying the plants, possibly through high moisture levels in the press, often appears to have caused all mature capsules to dehisce by the time they reach the herbarium sheet. As a result, the frequent lack of reaction to moisture and/or drying tests in herbarium material may be explained by the immaturity of the capsules.

Despite this the explosive nature has been found in a number of genera. The stimulus for this opening is of two types. The first mode of dehiscence, termed 'hygrochasic', is found in all Australian members of the subtribes Ruelliinae and Hygrophilinae. After contact with water, capsules explode violently and audibly, flinging the seeds a distance of up to 50 cm. In *Brunoniella*, *Hygrophila* and *Ruellia tuberosa*, the capsules possess a diamond-shaped or circular area at the apex which Sell (1969) investigated, and postulated to contain cells which trigger the violent opening. *Dipteracanthus* lacks any visible triggering area, but still reacts to water in the same way.

The second mode of dehiscence termed 'xerochasic' occurs in the tribes Justicieae and Andrographideae. The stimulus to opening is provided by drying of the capsules and was documented by Bremekamp (1926) and Sell (1969). This is much more difficult to investigate from herbarium material as the majority of capsules which are mature will have already split following the drying process. The capsules on my own *Andrographis*, *Rostellularia* and *Dicliptera* collections, which were for the most part closed on collection, were all split after drying. For those capsules on the collections which remain closed after drying, some response

was sometimes found. Capsules of *Sarojusticia* and *Nelsonia* did split violently in the former case after an initial wetting and then being allowed to dry out. In most genera collected, however, any capsules which were still closed were immature, although some of the capsules after wetting and then drying split slightly at the apex but no further. This may imply that the cells which initially respond to the opening stimulus are in the apex, but that there must be other parts of the capsule involved to complete the process.

From Sell's (1969) review of both xerochasic and hygrochasic dehiscence it would appear that the genera *Acanthus* and *Thunbergia*, for which dehiscence could not be observed, and other species of *Ruellia* are xerochasic. I have been able to confirm that some non-Australian species of *Ruellia* are xerochasic from living examples growing in the Adelaide Botanic Gardens. Thus the stimulus for dehiscence needs to be documented for species rather than making generalizations about genera. It may be that the stimulus will prove to be more related to the environment in which a species occurs than its taxonomy.

## 15. Seed

Seed morphology can be diagnostically useful at all levels. Thus, subfamily Thunbergioideae possesses by far the largest seeds in the family (except for *Acanthus*). They are unique in their cup shape, being smooth or reticulately patterned on the convex side with the rim invariably thickened and ribbed, and smooth on the convex surface (Fig. 1N). By contrast, the seeds of the Nelsonioideae are tiny and globose, those of *Nelsonia* covered throughout by linear ridges (Fig. 3F) and those of *Staurogyne* being reticulately ribbed (Fig. 3K).

The seeds of *Andrographis*, unlike the rest of the subfamily Ruellioideae (see below) are ellipsoid with a rugose surface and a more or less U-shaped groove (Fig. 19K), which makes them quite distinctive.

In the rest of the family the seeds are all compressed and usually more or less discoid. The seeds of *Acanthus* (Acanthoideae) are by far the largest of the compressed seeds (see below); their surface is closely rugose (Fig. 1J).

Among the Ruellioideae, seeds of tribe Ruellieae all possess mucilaginous hairs which become obvious on wetting by radiating out from the seed surface, and on drying cohere to each other and to the substrate, aiding in dispersal and establishment. The distribution of the mucilaginous hairs on the seed is frequently diagnostic at generic level. Thus, in *Dipteracanthus* and *Stephanophysum* the hairs are confined to the thickened rim (Fig. 8D), while in *Ruellia*, *Brunoniella*, *Hemigraphis*, *Hygrophila* and *Barleria* they are spread all over the seed surface (Fig. 11D, E). They are also found all over the surface in seeds of *Lepidagathis* of the tribe Lepidagathideae.

Within subtribe Odontoneminae seed shape can be used to separate genera. The Australian species of *Asystasia* have large irregularly angled margins and are sometimes tuberculate on the flattened surface (Fig. 19D), while *Pseuderanthemum* and *Graptophyllum* both have seeds which possess a small extension or 'tail', the seed of the former being almost orbicular in outline with an alveolate surface (Fig. 22I), and of the latter somewhat triangular in outline with a grooved surface (Fig. 25C).

In subtribe Diclipterinae the seeds of Australian *Dicliptera* fall into two types; the endemic species are completely smooth and the species with wider ranges are covered with conical bristles which are themselves barbed (i.e. glochidiate). The seeds of the rest of the subtribe are similar to those found in subtribe Justiciinae where they are usually discoid, and either smoothly tuberculate with the tubercles wart-like (the majority) or more rarely with the tubercles conical ('muricate'). Only rarely are hairs found in tribe Justicieae. Short hairs are found on the seeds of *Anisostachya tenella* of subtribe Justiciinae, as they are also in the allied genus *Monechma* of Africa. Whether they are mucilaginous is not known as there is only a single collection of the species for Australia.

## 16. Chromosome numbers

Chromosome studies are an area which has been little investigated in the past in Acanthaceae classification. They are clearly of importance in assessing relationships and phylogeny of the family.

Grant (1955) surveyed all the chromosome numbers known for Acanthaceae to that time and discussed them with respect to speciation and phylogenetic relationships. He concluded that any infrafamilial classification of Acanthaceae based on pollen morphology would probably be artificial as the basic chromosome numbers of 7, 8 and 9 in the resultant groupings suggest that the relationships between genera and species are more reticulate. In addition he found a large number of polyploids. Aneuploidy was documented in the genera *Andrographis*, *Asystasia*, *Barleria*, *Justicia* and *Thunbergia*, euploidy in *Dicliptera* and both aneuploidy and euploidy in *Acanthus*.

Within tribe Justicieae, Grant found that the genus *Justicia* s.l. was not homogenous, possibly having three basic numbers. Obviously more counts need to be obtained within *Justicia*. Work by Daniel et al (1984) documents *Justicia* s.l. as having meiotic chromosome numbers of 9-31, with the American species most commonly possessing counts of  $n = 14$ . A few counts obtained by workers in India (Navayanan 1951, Pal 1964) for species belonging to the *Justicia* (*Rostellularia*) *procumbens* complex indicate that this is probably a polyploid with a base number of 9. Daniel et al. (l.c.) suggest that the array of chromosome numbers could be due to aneuploidy and/or polyploidy, and it may also reflect a polyphyletic origin for the genus.

In contrast, Grant (1955) documents  $2n = 34$  for 27 American taxa of *Ruellia* and this is supported by  $n = 17$  for a further four Mexican species by Daniel et al. Unlike *Justicia* this uniformity in chromosome number may indicate a more natural assemblage of taxa. Chromosome counts for the segregate genera *Dipteracanthus* and *Brunoniella* could prove illuminating in analysing their relationship to *Ruellia*.

## B. POLLINATION AND FLORAL BIOLOGY

Pollination strategies within the Australian Acanthaceae are largely unrecorded. Only pollination in *Acanthus ilicifolius* (Primack et al. 1981) and the introduced *Thunbergia grandiflora* (Burkill, fide Bor & Raizada 1954) have been previously documented. The following discussion considers the value of a number of floral characteristics which participate in or aid pollination with reference to overseas work on allied taxa or similar pollination syndromes.

All Acanthaceae species in Australia possess flowers which appear to be well adapted for cross-pollination, although it is probable that these same flowers are also capable of being self-pollinated. Some species within a few genera also produce tiny flowers which apparently rely entirely on self-pollination. It is convenient to deal with the flowers principally involved with the two general strategies of cross- and self-pollination evident within the family.

### 1. Allogamy or Cross-pollination

Many acanthaceous flowers display floral structures reflecting different pollination syndromes, often paralleling those found in the Labiatae and Scrophulariaceae, the extensive documentation of which has been reviewed by Faegri & van der Pijl (1979). In Table 4 flowers of Australian genera and species have been grouped into the different types of floral structure or "blossom classes" (modified after Faegri & van der Pijl l.c.) with an attempt to document their attractions to pollinators and the possible nature of the pollinators.

All blossom classes have nectar and pollen as an attractant. Nectar is always produced at the base of the corolla tube, which is usually narrowed towards its base making access more difficult. Extra-floral nectaries in the form of cup-shaped glands on the bracts or bracteoles are found in two introduced species, *Thunbergia grandiflora* and *Barleria lupulina*, but there is no evidence of them in any of the species native to Australia. Burkill (Bor & Raizada l.c.) observed the function of the extra-floral nectaries in *T. grandiflora*. They occur on the bracteoles enclosing the corolla tube and attract ants thus preventing "nectar robbing" by the usual pollinators, bees of the genus *Xylocopa*. In order to obtain nectar the bees must approach the flower via the corolla mouth and so achieve pollination. In *Barleria lupulina* the extra-floral nectaries occur in a similar position on the bracts enclosing the base of the corolla tube; they may have a similar function to those of *T. grandiflora*, but this requires investigation.

Flower colour is predominantly white or pink-purple, with the colour usually found on the lobes and the tube remaining white or at least paler in colour. In this way there exists a colour gradient leading to the nectary. There are also usually contrasting areas of colour on the lobes of the corolla which serve as nectar guides to visitors. Such guides take the form of striations in *Staurogyne* and some species of *Thunbergia*, the barred white and pink purple area on the lower lip of a number of genera in the subtribe Justiciinae, the spots on the anterior lobe of some *Pseuderanthemum* species and the varied blotches of darker colour on the upper lip of such genera as *Dicliptera*, *Hypoestes* and *Andrographis*. The deep red-purple corollas with a recurved lower lip, found in the large-flowered *Grapiophyllum* species of Australia, presumably attract bird visitors.

Anthers may also function as guides in genera such as *Acanthus*, *Dicliptera*, *Pseuderanthemum* and *Andrographis*. All have anthers of a dark colour, or providing a distinct contrast to the basic colour of the corolla and sometimes similar to its markings. They may form part of the nectar guide system or may be advertising their pollen content.

The floral structures found in the Australian Acanthaceae can usefully be compared under the different blossom classes, as summarised in Table 4. In the absence of extensive field observation it is dangerous to speculate about the activities of pollinators based only on consideration of floral syndromes, but it is all that is available at the moment.

#### a. Funnel blossoms

This blossom type has a funnel-shaped corolla with a throat wide enough to accommodate insect visitors, a necessity if pollination is to be carried out since the stamens are contained within the throat of the corolla tube. The genera *Staurogyne* and *Nelsonia* of subfamily Nelsonioideae both belong to this group. Their small flowers, particularly in *Nelsonia*, indicate that the pollinators must be small if they are to enter the flower. In the case of *Staurogyne* any approach to the mouth of the flower should ensure pollen being deposited randomly on the visitors body since the 4 stamens are arranged around the tube. In *Nelsonia*, where the flowers are smaller still, the arrangement of the two stamens appears to be such that they block access to part of the mouth of the corolla tube and so pollen deposition may not be random.

In *Didcladanthra* which has a large funnel-shaped flower, the stamens with their U-shaped connectives are placed on the opposite side of the flower to the style with its downcurved stigma. For pollination to occur it is assumed that approach to the flower is again random and pollen can be transferred to any surface of a visitor, otherwise there is no way in which the stigma can be pollinated. It seems likely that pollen transfer onto a visitor is facilitated by the U-shaped connective. This ensures that the pollen supply at the apex of each arm is more widely spread around the corolla tube than in flowers with the conventional adjacent anther cells.

In all three genera discussed here the stigma and anther cells are at a similar level and, unless there is a difference in their maturation times, or a pollen stigma incompatibility, it should be possible for self-pollination to occur.

Blossom-class	Funnel	Funnel-Gullet Transition	Trumpet	Gullet	Modified Gullet	Modified Gullet	Flag
Australian representatives	<i>Staurogyne</i> <i>Didcladantha</i> <i>Nelsonia</i>	subtribe Ruellinae <i>Thunbergia</i> <i>Ayscia</i> p.p.	<i>Pseuderanthemum</i> <i>Ayscia</i> p.p. <i>Dipleracanthus bracteatus</i>	subtribe Justiciinae, <i>?Peristrophe brassii</i> <i>Xerolhamnella</i> <i>Hypophila</i> <i>Gratiophyllum spinigerum</i>	<i>Acanthus</i>	large red-flowered <i>Gratiophyllum</i> spp.	<i>Hypoestes</i> <i>Didcliptera</i> <i>Andropogonis</i> extra Australian <i>Peristrophe</i>
Flower colour	white	white, blue, pink, rarely orange ( <i>T. alata</i> )	white, blue or pink	white with pink, red or purple lobes or coloured spots	white or blue	red-purple	white or pink-purple
Guides	sitratons in <i>Staurogyne</i>	sitratons in <i>Thunbergia</i> spp., ?palate in <i>Ayscia</i> and Ruellinae	spots in <i>Pseuderanthemum variable</i> p.p., exserted anthers contrasting colour	barred pink and white area on lower lip, coloured spots or areas	dark coloured anthers	flower colour	upper lip with dark blotches, spots or sitratons. Anthers often dark coloured
Attractant	Nectar (hidden) Pollen	Nectar (hidden) Pollen	Nectar (hidden) ?Perfume in <i>D. bracteatus</i>	Nectar (hidden) Pollen	Nectar (hidden) Pollen	Nectar (copious)	Nectar (hidden) ?Pollen
Barriers to visitors		basal anther awns pubescence in corolla tube	length and narrowness of tube	palate, hairs in tube	constriction and ring of hairs at top of tube, thick and curved filaments, hairs on lower lip	hairs in throat, lack of a landing platform for to recurvature of lobes	hairs on abaxial surface of filaments, narrowing of tube through twisting through 180°, involucre prevents nectar robbery in <i>Hypoestes</i> , <i>Didcliptera</i> , length of corolla tube
Stamens and stigma	included	included, held against adaxial surface	at least one pair of stamens exserted	usually exserted from throat but protected by upper lip	exserted, no protection due to lack of upper lip	just exserted, not protected by upper lip	far exserted, no protection by upper lip
Place of pollen deposition on visitor	diffuse or random	on the back (nototrohic)	various or on head	on the back (nototrohic)	on the back (nototrohic)	on head or back	on abdomen
Probable pollinator	bees (entry by crawling)	bees (entry by crawling)	moths, butterflies	bees alighting on lower lip	birds, strong bees	birds	moths, butterflies, ?larger bees

Table 4: Blossom classes of Australian Acanthaceae

### b. *Funnel-gullet transition*

A number of species of subtribe Ruelliinae, *Thunbergia* and *Asystasia* appear to be "funnel blossoms" by their more or less regular funnel-shaped corolla, but have a tendency to zygomorphism by the abaxial side of the tube being longer than the adaxial, and the stamens and stigma being appressed against the adaxial surface. By its projection past the adaxial surface the abaxial surface of the flower functions as a landing platform. The abaxial surface is frequently marked in some way, apparently as a guide to pollinators, by striations in *Thunbergia*, or a palate-like ribbing in *Asystasia* and the genera of subtribe Ruelliinae. This is similar to the situation in "gullet blossoms" (see below). Since the stamens are still included in the throat, for pollination to occur a visitor still needs to enter the throat. Because of the landing platform and nectar guides it can be predicted that, in contrast to funnel blossoms, visitors will only enter the mouth of the corolla tube from one direction and so pollen will be deposited on the backs of visitors in search of nectar at the base of the tube. In introduced *Thunbergia* species such pollen deposition will be aided by the long, hardened, basal anther spurs. While these are usually lacking in the native *T. arnhemica*, they are sometimes replaced by short hairs on the anther cells which may have the same ultimate function. In this last species, hairs forming a ring or a series of clumps at the base of the corolla throat may act either as a deterrent or as a guide to visitors.

In flowers of subtribe Ruelliinae, hairs are usually present either on the adaxial surface of the tube or on the filaments and style held against the adaxial surface. These may be sufficient to encourage visitors to be correctly orientated for nototrobic pollen transfer or they may discourage smaller insects from taking the pollen.

In *Thunbergia* and subtribe Ruelliinae the stigma is projected above the stamens and for self-pollination to occur, pollen would have to be transferred as the visitor leaves the flower. This is apparently prevented in *Thunbergia* by the bee as it leaves the flower pressing the non-receptive lower half of the stigma up against the receptive stigma area; since the bee contacts only the non-receptive lower surface of the stigma, pollination is prevented (Burkill, 1954). Within subtribe Ruelliinae however, the only mechanism preventing this is partial dichogamy in American species at least (Long 1976), the stamens being mature before the stigma. Whether this difference in maturation time occurs in the Australian *Dipteracanthus* and *Brunoniella* species is not documented. Nor has the significance of the pubescence of the stigma lobe in *Brunoniella* compared with its glabrous nature in *Dipteracanthus* and *Ruellia* been investigated.

### c. *Trumpet blossoms*

These blossoms are characterised by a long and narrow corolla tube, the narrowness and length precluding all but visitors with a long proboscis, such as moths and butterflies, having access to the nectar at the base of the tube. Since the anthers are usually just exerted from the tube, pollen is usually deposited on the head of the pollinator. Such characteristics are found in some *Pseuderanthemum* species, *Asystasia australasica* and *Dipteracanthus bracteatus* of Australia.

*Dipteracanthus bracteatus* has white flowers with a corolla tube 3-4 cm long. The corollas open at night and drop early in the morning. Accordingly it is likely that the flowers are moth-pollinated; they might be expected to have a nocturnal perfume.

*Pseuderanthemum variabile*, which for the purposes of this work has been treated as one very polymorphic species, possibly has two pollination strategies which may indicate the existence of at least two different taxa. The long-tubed flowers of the Northern Territory and more northern parts of Queensland are white with no spots on the anterior lobe and with only the erect, black anthers providing colour contrast (Fig 22). The generally shorter-tubed flowers of New South Wales and southern Queensland are often pink with coloured spots on the



anterior lobe. In this flower type the anterior lobe may have in addition eglandular hairs which could function as an aid to an alighting visitor. In intervening regions there is a transition in the two sorts of flower. It would appear that because of the long corolla tubes the flowers in the northern regions would require moths or butterflies to tap their nectar source, while the spotted flowers of the south-eastern regions have shorter tubes possibly visited by insects, such as bees with shorter mouth parts. Field observations are required to clarify this and to determine the role of pollen foragers in pollination in this species.

By the position of exerted anthers and the stigma being at a similar height the taxa considered here are perhaps facultative self-pollinators, but observations are needed on relative maturation times of anther and stigma and compatability in the one flower.

#### d. Gullet blossoms

Gullet blossoms are invariably 2-lipped with the lower lip providing a landing platform for the visitor. The stamens are held against the upper (adaxial) lip and pollen deposition is on the back of the visitor. The upper lip usually provides weather and physical protection for the anther cells and in some cases (subtribe Justiciinae) has a style channel which holds the style in place.

The majority of 2-lipped flowers in Acanthaceae in Australia are gullet flowers. The lobes are often pink, mauve or purple, with a gradation of intensity into the white corolla tube, often accompanied by additional markings such as the barred area running into the throat on the lower lip of *Rostellularia*, *Sarojusticia* of subtribe Justiciinae and *Hygrophila* of subtribe Hygrophilinae. *Xerothamnella parvifolia*, ?*Peristrophe brassii*, *Graptophyllum spinigerum*, *Calophanoides hygrophiloides* and *Rhaphidospora bonneyana* all have red or purple spots or blotches in the throat of their predominantly white flowers.

The two endemic Australian species of *Xerothamnella* have flowers which differ from the normal gullet flower in Acanthaceae i.e. a 2-lipped corolla with a narrow, emarginate upper lip and a 3-lobed lower lip. While the lower lip of *X. herbacea* is 3-lobed, the broad upper lip has 2 lobes, each deeply emarginate and therefore effectively 4-lobed. In *X. parvifolia* the upper lip is also broadly 4-lobed, but the lower is narrow and entire. W.R. Barker (pers. comm. 1984) reports that on any one bush the orientation of the flower can range from adaxial lip uppermost, corolla limb horizontal or adaxial lip lowermost. The entire, narrow, lower lip is bright red-pink and there is a smaller patch of the same colour on the upper lip. This smaller patch of colour usually coincides with the level of the stigma. The two shorter stamens with their apical anther cells are ranged on either side of the style with the anther cells curving in towards the centre of the flower when young in a similar fashion to the way the anther cells curve towards the centre of the flower in the closely related genus *Dicladanthera* (see funnel flowers above and Fig. 30). The anther cells move apart with age. In the *X. parvifolia* flower it is not known how pollen is actually transferred to the stigma, or the role of the coloured patch on the 4-lobed adaxial lip. There seems little doubt that it functions as a gullet flower although there is the possibility that the visitor approaches the narrow abaxial lip by using the stamens and 4-lobed lip as the landing platform (i.e. the reverse of the normal nototrobic approach of visitors to gullet flowers). Similarly the situation needs to be investigated in the other poorly known species, *X. herbacea*.

Within the gullet flowers of *Rostellularia* and *Sarojusticia* at least, observations demonstrate that the two stamens seem to mature before the stigma. Having lost their pollen they move apart from their initial close position under the upper lip exposing the stigma. A similar occurrence has been noted in the 'flag' blossoms of *Dicliptera* and *Hypoestes* (see below).



A number of Australian representatives of subtribe Justiciinae (*Rostellularia*, *Sarojusticia* and *Calophanoides*) have hairs on their anther backs. These may be related in some way to pollination. As the hairs are present on the backs of the anthers, on the opposite side to the opening of the sutures, they appear to have no function in the actual transfer of pollen, but may be involved in positioning of the anthers. Even this seems unlikely however in view of their relatively fragile nature and the lack of other hairs on the corolla tube with which they could interlock, although it may be possible for them to connect with the style channel.

A number of varieties of *Rostellularia adscendens* are separable predominantly on flower size. Within the pairs var. *pogonantha* and var. *latifolia*, var. *junceae* and var. *hispida*, var. *clementii* and var. *largiflorens* similar vegetative characters are displayed but one variety possesses large and the other smaller flowers. However, the flowers of both still appear to be cross-pollinated and the flower size difference may relate only to the size of pollinator.

#### e. Modified gullet blossoms

The two native *Acanthus* species have modified gullet flowers. In these, the upper lip is absent leaving the robust filaments and anther cells to carry out its function; the reduced adaxial calyx lobe is long enough to provide protection for the nectary. This is in contrast to flowers of introduced European *Acanthus* species where the role of the upper lip is taken over by the enlarged calyx lobe.

The presence of glands on the backs of the anthers and apex of the filaments of *A. ilicifolius* and the absence of such glands in *A. ebracteatus* is perhaps of significance to the floral biology of these species and needs to be investigated. They could possibly serve as nectaries as in *T. grandiflora* (Faegri & van der Pijl, 1979) or they could be responsible for the production of perfume. Even though Primack et al. (1981) have documented the pollination strategy of *A. ilicifolius*, there still remain a number of areas requiring investigation.

The large-flowered *Graptophyllum* species are also modified gullet flowers since no landing platform is provided by the lower lip. Because of their size, their deep red-purple colour, copious nectar production and recurved lower lip it would seem most likely that they are pollinated by birds.

#### f. Flag blossoms

Flag blossoms are a reversal of gullet blossoms, such that instead of insect visitors having pollen transferred to their backs or heads (nototrobic) it is transferred to their underside (sternotrobic). In gullet flowers the stamens are closer to the adaxial lip, with the anther sutures opening downwards and visitors having pollen deposited on their upper surface when they land on the abaxial lip. In the flag blossoms the apparent upper lip is 3-lobed while the lower is emarginate, a twisting through 180° of the arrangement found in gullet flowers. In *Hypoestes*, *Dicliptera* and non-Australian *Peristrophe* this is achieved by resupination of the corolla tube. In *Andrographis paniculata* it is simply caused by the orientation of the blossom as there is no resupination of any of the floral parts.

Because of this rearrangement the anthers dehisce upwards (towards the adaxial surface) and pollen is gained by insects crawling over the top of the anthers and is deposited on their abdomens. As a consequence the filaments function as the landing stage. Should the insect use the upper lip as a landing platform, pollination would not occur because of the exertion of the anther cells past the corolla throat (Figs 19I & 36E). Because of exertion of the stamens the distance between the nectar source and the sexual organs is large, and to be effective the pollinator must possess a proboscis of sufficient length to probe the tube, while the body must be of sufficient length to contact the anther cells. Another alternative in *Hypoestes* and *Dicliptera* is for pollen foragers alone to carry out pollination, since the stigma and anthers are

at a similar height. As in other genera the stamens tend to hold together at an early floral stage with the style held well above. Later the stamens move apart and the style descends to their level. In *Andrographis paniculata* the style is actually held between the two stamens (Fig. 19I) and the stigma is held in position at the base of the anther cells. The presence of a group of hairs at the base of the anther cells may help to brush pollen from visitors onto the stigma.

Other difficulties which unspecialised pollinators would encounter in trying to tap the nectar of these flowers are the narrowness and twisting of the tube (in *Hypoestes* and *Dicliptera* at least) and the presence in the corolla tube of pubescence decurrent from the filaments. The flowers seem to be prime targets for "nectar thieves". However the tube containing the nectar is often enveloped within a pair of involucral bracts which are sometimes appressed and spiny (*Dicliptera*), or sometimes fused together (*Hypoestes*). These bracts would help prevent 'theft' of nectar from the base of the tube, but they do not prevent insects taking nectar by approaching the flower below the stamens, as observed in the visits by honey bees (*Apis*) to cultivated exotic species of *Hypoestes* in the Adelaide Botanic Garden. Access to nectar by this "incorrect" approach, via the lower surface, appears to be discouraged by the presence of hairs on the abaxial surface of the filaments while the adaxial surface (landing stage) remains glabrous. The lower lip is structured so that it does not provide a landing stage. This is achieved in *Hypoestes* and *Andrographis* by marked recurvature, while in *Dicliptera* the lower lip is usually vertical.

## 2. Autogamy

Autogamy is involved in the common, but often overlooked, cleistogamous flowers of a number of species of Acanthaceae and is potentially involved with the chasmogamous or large, showy, open flowers already discussed.

The large chasmogamous flowers of *Thunbergia alata* and *Graptophyllum excelsum* are capable of self-fertilization since single plants produce occasional capsules. Such self-fertilization must have taken place by geitonogamy or autogamy. Within the *Ruellia* species of America Long (1976) has already noted that the chasmogamous flowers are self-compatible while exhibiting partial dichogamy. However, Camerloher (in Bremekamp 1955) found that the flowers of *Thunbergia grandiflora* are self-incompatible. Further observations are required to catalogue the reproductive behaviour of the chasmogamous flowers.

A frequent trait associated with autogamy in the Australian Acanthaceae is cleistogamy, here used in the sense of self-fertilization occurring within the unopened flower. A number of Australian genera contain species which produce cleistogamous flowers, but all of these species also produce large, open and apparently predominantly chasmogamous flowers on the same plants. The cleistogamous flowers differ from the chasmogamous not only in size, but also modifications to the androecium or gynoecium.

In a review of cleistogamy, Lord (1981) refers to such floral dimorphism as "true" cleistogamy (a paradoxical term in view of the derivation of cleistogamy). A prerequisite for "true" cleistogamy, according to Lord (l.c.) is that the cleistogamous flowers must differ from the chasmogamous (which can be produced on the same or different plants) not only in a lack of expansion of the corolla at anthesis, but also by modifications in the floral structures. The implication is that the cleistogamous and chasmogamous flowers are a result of divergent developmental pathways, with many factors influencing the pathway taken. Lord also reports the production of many intermediate forms between cleistogamous and chasmogamous flowers in plants which exhibit "true" cleistogamy. This has not been observed in species of Australian genera, but it may account for flower size differences in the polymorphic *Pseuderanthemum variabile* and to a lesser extent *Dipteracanthus australasicus*.

A "true" cleistogamous breeding system has been observed in Australian Acanthaceae in *Dipteracanthus*, *Brunoniella* and the introduced species of *Ruellia*, all belonging to subtribe Ruelliinae, in *Pseuderanthemum* of subtribe Odontoneminae and in *Dicliptera* of subtribe Diclipterinae. It is also possible that it occurs within the large-flowered species of *Graptophyllum*. Because of their insignificance, cleistogamous flowers are frequently overlooked and they have not apparently been previously documented in the Australian literature. Their existence outside Australia has been noticed (Scott 1872: *Eranthemum*; Uphof 1938: *Dicliptera*, *Dianthera*, *Blechum*, *Aechmanthera* and *Eranthemum*; Long & Uttal 1962: *Ruellia* and Backer & Bakhuizen van den Brink 1965: *Dicliptera*).

Cleistogamous flowers in Australian taxa have the appearance of buds of chasmogamous flowers which occur on the same plant; frequently the only indication that cleistogamy has occurred is the presence on the apex of the capsules of tiny remnant styles (see Fig. 22A), or sessile stigmas or tiny remnant corollas which may also be scattered on the foliage or ground below. Closer observation of the buds will then reveal them as tiny unopened flowers in which the pollen is already mature and being shed from the anthers. The anthers in such flowers may themselves be reduced. In *Pseuderanthemum variabile* the anther cell number is reduced from two to one comparing chasmogamous to cleistogamous flowers. However, in the Australian *Dicliptera* species which exhibit cleistogamy, the anthers are reduced only in size. It could be argued that since there is only a size difference between the chasmogamous and cleistogamous flowers of *Dicliptera*, these do not exhibit "true" cleistogamy but "pseudo" cleistogamy, defined by Lord (l.c.) as a lack of any morphological differences between the two flower types apart from expansion at anthesis. Such "pseudo cleistogamy" is induced by environmental factors while "true" cleistogamy is both genetically and environmentally influenced. Within the *Dicliptera* species, the corolla of the cleistogamous flower shows an apparent lack of twisting of the corolla tube through 180°, a characteristic of the chasmogamous flower. Thus it appears that there is possibly a different developmental pathway between the two flower types and *Dicliptera* may exhibit the characteristics of "true" cleistogamy.

It is not always possible in Australian Acanthaceae to distinguish cleistogamous flowers from the buds of chasmogamous flowers, particularly when there is no associated reduction in parts. This, together with a paucity of collections, accounts for uncertainty about the occurrence of cleistogamous flowers in *Graptophyllum*, although the presence of some short styles on capsules possibly indicates their presence.

The production of cleistogamous flowers has often been related to climatic conditions (Uphof 1938). This observation seems to be supported by my own observations in *Pseuderanthemum variabile*, where the tiny flowers are apparently produced in the wet season, while large, chasmogamous flowers are produced during the dry. Whether this is related to pollinator activity is not known.

Climatic conditions do not seem to play a part in determining the type of flower produced in Australian *Dicliptera* and *Ruellia* species. Both flower types are present at the same time and within the same inflorescence. Schorer in Uphof (1938) showed that crowding within bracts contributed to the production of cleistogamous flowers and that removal of the crowding allowed the production of larger flowers. However, apparently equally crowded inflorescences of *Dicliptera* sometimes have flowers which are entirely chasmogamous, entirely cleistogamous, or a mixture of the two types.

More recent work (Lord l.c.) suggests that cleistogamy is the result of both genetic and environmental factors, but further study is required before an understanding of their relative contribution to the resultant reproductive system is achieved. At a physiological level little is known of the mechanism which induces the plant to produce cleistogamous or chasmogamous flowers, although both of the hormones, gibberellin and abscisic acid have been implicated (Lord l.c.).

At the population level more needs to be known about the relative importance of chasmogamous and cleistogamous flowers to the next generation and their relationship to each other. Judging from observations made by Scott (1872) on Indian *Eranthemum* (= *Pseuderanthemum*), Long & Uttal (1962) on *Ruellia* s.lat. and observations here on *Dicliptera* and *Pseuderanthemum*, cleistogamous flowers may be responsible for the majority of mature seeds and capsules produced.

More needs to be known of the genetic relationship of the two flower types. Apparently artificial crosses between cleistogamous and chasmogamous flowers on the same plant are unsuccessful (Scott l.c.; Lord 1981), probably because of pollen-stigma incompatibility. Observations in *Streptocarpus* (Gesneriaceae), *Viola* (Violaceae) and *Oxalis* (Oxalidaceae) by Pargney (in Lord 1981) indicate that pollen differences between chasmogamous and cleistogamous flowers can be expected to be subtle and not detectable by the light microscope. A preliminary look at pollen of chasmogamous and cleistogamous flowers of the Australian species *Dicliptera armata*, with the scanning electron microscope reveals no apparent difference in structure between the two, but this is a question that should be addressed further in view of the importance placed by some workers on the pollen morphology in subdividing the family.

#### ACANTHACEAE A.L. Juss. nom. cons.

**Acanthaceae** A.L. Juss., Gen. Pl. (1789) 102 (as 'Acanthi'); R. Br., Prodr. (1810) 472; Nees in Wallich, Pl. Asiat. Rar. 3 (1832); Nees in A. DC., Prodr. 11 (1847) 46; T. Anderson, J. Linn. Soc., Bot. 7 (1864) 13; T. Anderson, J. Linn. Soc., Bot. 9 (1867) 425; Benth., Fl. Austral. 4 (1868) 541; Lindau in Engl. & Prantl, Nat. Pflanzenfam. IV, 3b (1895) 274; Bailey, Qld Fl. 4 (1901) 1140; Domin, Biblioth. Bot. 89 (1929) 601; Bremek., Verh. Kon. Nederl. Akad. Wetensch., Afd. Natuurk., 45 (1948) 3; Bremek., Bull. Bot. Surv. India 7 (1965) 21; R.M. & W.R. Barker in Morley & Toelken, Fl. Pl. Austral. (1983) 282.

Prostrate, erect or rarely climbing herbs, shrubs or rarely small trees, monoecious, sometimes spiny, usually with cystoliths (lacking in subfamilies Thunbergioideae, Nelsonioideae and Acanthoideae). *Branches* decussate, frequently angled, more rarely terete, often with transverse ridge across node. *Leaves* decussately arranged (or rarely in the upper parts of members of subfamily Nelsonioideae alternate), simple, entire or shortly toothed, rarely spiny and deeply incised, exstipulate. *Inflorescence* axillary or terminal, often producing both chasmogamous and cleistogamous flowers; flowers solitary or arranged in spikes, cymes or racemes, often very densely clustered, frequently in axils of a bract and with two bracteoles at their base, bracteoles sometimes lacking, bisexual. *Bracts* and *bracteoles* usually not showy in Australian native taxa, small, often leaf-like, sometimes enclosing corolla tube, often conspicuous and/or coloured in introduced taxa. *Calyx* segments 4-5, or rarely (Thunbergioideae) an entire ring, or 8-20-lobed. *Corolla* sympetalous, 5-lobed, regular to irregular, frequently 2-lipped, upper lip rarely lacking (*Acanthus*), lobes imbricate or contorted in bud, basally usually divided into a distinct narrow tube and wider throat, tube rarely twisted through 180°. *Stamens* either 4 fertile and then usually didynamous, or 2 fertile and sometimes accompanied by 2 staminodes, inserted on corolla tube; filaments free or basally connate in pairs; anthers cells usually 2, cells inserted at same or different levels, more rarely 1, usually parallel, rarely diverging or transverse, frequently with hairs or basal spurs, dehiscent longitudinally, (except in *Nelsonia* appearing to open by a basal flap); pollen varied in structure, most commonly tri-colporate. *Disc* annular and nectar-producing at base of ovary, sometimes the rim with appendages, or undulate. *Ovary* 2-celled, superior, either with 2 collateral (Thunbergioideae) or more commonly 2-10 superposed ovules per cell, rarely (Nelsonioideae) with numerous ovules in 2 rows in each cell; placenta axile; style terminal; stigma entire or more usually 2-lobed, one of lobes frequently smaller than other. *Fruit* a loculicidal, 2-valved capsule, with 2-many seeds, frequently explosively dehiscent either on drying or application of water, seed-bearing throughout or seeds restricted to either basal or

apical half, seeds subtended at their base by conspicuous hooks, (retinacula or jaculators derived from hardened funicles), hooks persisting in capsule after seed has been lost, or lacking in Thunbergioideae and Nelsonioideae. *Seed* usually compressed and discoid, sometimes with mucilaginous hairs which expand on wetting, or hairs lacking and testa variously marked, or rarely (in Nelsonioideae), tiny and globose (in Thunbergioideae) large, semiglobose and excavated on one surface.

### *Distribution*

The family Acanthaceae consists of approximately 250 genera and c. 2500 species. It is widespread in tropical regions but more sparingly distributed in temperate areas. The majority of genera world wide are to be found within subfamily Ruellioideae and this holds true for the Australian representatives as well. Within that subfamily the largest genera are *Justicia* and *Ruellia* which are discussed further below. In Australia there are 28 native and naturalised genera with 57 species.

### Key to subdivisions of Acanthaceae in Australia

- 1a. Twiners or climbers. Calyx an entire ring, or 10-20 shortly-toothed lobes. Capsule with a prominent beak. Seeds large, semiglobose, excavated on the ventral surface, 1-2 per valve. subfamily Thunbergioideae (genus 1).
- 1b. Prostrate or erect herbs or shrubs. Calyx 4-5-lobed. Capsule not prominently beaked. Seeds distinctly flattened, or if not flattened, tiny and globose, not excavated on one surface, usually 2 or more per valve ..... 2
- 2a. Bracts and upper leaves alternate. Seeds without hooks at their base, not flattened, 12 or more per valve. [Plants without cystoliths] ..... subfamily Nelsonioideae (genera 2-3)
- 2b. Bracts and upper leaves opposite. Seeds with hooks at their base, flattened (except *Andrographis*), 1-20 per valve ..... 3
- 3a. Cystoliths absent. Stamens 4, anthers 1-celled. Each opposite pair of leaves not joined across node by a transverse ridge ..... subfamily Acanthoideae (genus 4)
- 3b. Cystoliths present. Stamens 2 or 4, if 4 (in Australia) always 2-celled. Each opposite pair of leaves joined across node by a transverse ridge. [subfamily Ruellioideae (genera 5-28)] ..... 4
  - 4a. Seeds without mucilaginous hairs which rapidly expand on exposure to water. Stamens 2 or 4 ..... 9
  - 4b. Seeds with hairs which rapidly expand on exposure to water. Stamens 4 ..... 5
  - 5a. Seeds 1-2 per valve. Capsule seed-bearing only at base. Stigma entire or 2-lobed ..... 8
  - 5b. Seeds more than 2 per valve. Capsule seed-bearing for whole length or in apical parts only and stipitate at base. Stigma unequally 2-lobed. [tribe Ruellieae (excluding Barleriinae) (genera 5-10)] ..... 6
    - 6a. Filaments basally united in pairs. Flowers more or less actinomorphic. subtribe Ruellinae (genera 5-8)
    - 6b. All 4 filaments basally connected. Flowers 2-lipped or more or less actinomorphic ..... 7
    - 7a. Flowers 2-lipped. Corolla without 2 rows of hairs to hold style. Stigma not compressed ..... subtribe Hygrophilinae (genus 10)
    - 7b. Flowers more or less actinomorphic. Corolla with 2 rows of hairs on adaxial side to hold style. Stigma laterally compressed ..... subtribe Strobilanthiniae (genus 9)
  - 8a. Calyx lobes 5 ..... tribe Lepidagathideae (genus 12)
  - 8b. Calyx lobes 4 ..... tribe Ruellieae subtribe Barleriinae (genus 11)
  - 9a. Seeds not flattened. Capsule cylindrical. Seeds 6 or more per valve ..... tribe Andrographideae (genus 13)
  - 9b. Seeds flattened. Capsule club-shaped except in *Dicliptera* where it is discoid with a short apical beak. Seeds 1-2 per valve. [tribe Justiciae (genera 14-28)] ..... 10
    - 10a. Stamens 4 or 2 with 2 staminodes, the two anther cells always inserted at equal levels ..... subtribe Odontomeminae (genera 14-16)
    - 10b. Stamens 2, lacking staminodes, the two anther cells inserted at unequal levels (except in *Dicliptera australis* and *D. arnhemica* where they are equally inserted) or separated laterally or the anthers 1-celled (*Hypoestes*) ..... 11

- 11a. Corolla actinomorphic or 2-lipped, if the latter, the upper lip without ridges to hold style in place ..... 12
- 11b. Corolla 2-lipped, the upper lip with 2 ridges to hold the style in place ..... subtribe *Justiciinae* (genera 23-28)
- 12a. Stamens with anther cells not superposed but with an apical, transverse anther cell or the anther cells separated laterally. Flowers regular or 2-lipped, the upper lip 4-lobed or 2-lobed with the lobes notched. [Corolla tube not twisted through 180°] ..... subtribe unknown (genera 17-18)
- 12b. Stamens with anther cells superposed (except in *Dicliptera australis* and *D. arnhemica*), or with 1-celled anthers inserted parallel to filament. Flowers distinctly 2-lipped, the upper lip 3-lobed or notched ..... 13
- 13a. Corolla tube twisted through 180° (except in ? *Peristrophe brassii*), surrounded by paired involucre bracts either unequal and free or fused into a cylinder, the bracts equal to or exceeding calyx ..... subtribe *Diclipterinae* (genera 19-21)
- 13b. Corolla tube not twisted through 180°, not surrounded by involucre bracts, bracts much less than calyx ..... subtribe *IsoGLOSSINAE* (genus 22)

### Generic circumscription of *Ruellia* and *Justicia*

The problem of the generic circumscription of *Ruellia* and *Justicia* will not be resolved until the genera are revised world wide. The problems associated with the two are similar; both genera are large (c. 600 species in *Justicia* s.l., pers. comm. R. Brummitt 1985, and 250 in *Ruellia*), both have been split into a number of segregate genera chiefly by Nees von Esenbeck (1847a), followed by adoption of broader generic concepts by Anderson, Benthams, Lindau and Clarke and then resurrection of the segregate genera by Bremekamp, particularly for Malesia. In both genera, modern treatments in both the Americas and Africa have adopted a broad circumscription, while Malesian botanists have tended to narrower concepts. This last circumstance has partly arisen because of Bremekamp's clarification of the segregate genera for Malesia, whereas there has been no equivalent modern work on either *Ruellia* or *Justicia* in America or Africa where there is confusion about segregate generic concepts (Long 1970, Stearn 1971).

#### a. *Justicia*

Opinions vary as to the circumscription of *Justicia* depending on which species is selected as lectotype and whether one accepts the generic concept in the broad or narrow sense. Britton (1918) proposed that *J. adhatoda* be considered the type of *Justicia* and if this is accepted then *Justicia* s.s. becomes limited to about 10 species from Africa which are usually (Clarke 1900, Heine 1963), referred to the genus *Adhatoda*. If *J. hyssopifolia* is chosen as lectotype as proposed by Hitchcock & Green (1929) and supported by Bremekamp (1948), then *Justicia* s.s. would be confined to a few Canary Islands and African species.

Stearn (1971) examined the question of the Linnaean types of *Justicia* at some length and from his discussion there seems little doubt that *J. adhatoda* L. should be considered the type of the genus. Stearn (l.c.) showed that the original generic description of *Justicia* (Linnaeus 1754) was based upon Linnaeus's earlier (1737) description of this species. However, in 'Species Plantarum' Linnaeus (1753) listed eleven species which he referred to *Justicia* and so by Art. 13 of ICBN all of these become eligible for selection as the lectotype of the genus. A choice between the two species already mentioned as lectotypes must be made by a reviser of *Justicia* sensu lato.

Within Malesia, where Bremekamp carried out work on Acanthaceae, the narrow concept of *Justicia* is usually adopted with the recognition of a number of segregate genera such as *Rostellularia*, *Rhaphidospora*, *Calophanoides* and *Strophacanthus*. Within Africa and to a greater extent in the Americas, a broad generic circumscription of *Justicia* has been applied in

local floras and the authors are often critical of Bremekamp's approach claiming that he has narrowed the generic concept too much (Long 1970). The problem in these areas, however, lies more with which of the segregate genera to assign species to if a narrow concept for *Justicia* is adopted. C.B. Clarke's recognition of sections of *Justicia* (Clarke 1885, 1900, 1907) has facilitated splitting of *Justicia* in India and Malesia, whereas there seems to have been either no attempt to do this in the Americas, or attempts to separate groups predominantly on anther cell arrangement, have not met with success (Leonard 1958, Gibson 1973).

It may be that too many genera have been recognised in Malesia and the answer to the problem is a less exclusive concept of the genus. A world wide review of *Justicia* s.l. presently being prepared for publication at Kew places all segregate genera within *Justicia* with recognition of a number of sections. The total scope of this treatment has not yet been fully assessed, but it would seem from conversation with the authors Graham & Brummitt that there may be some problem in finding characters to distinguish this more widely circumscribed *Justicia*.

Within this work I have chosen, as has been usual in Malesia, to adopt a narrow concept of *Justicia*. The species are morphologically diverse in Australia, and the use of genera rather than sections seems more appropriate. However, this diversity is a characteristic of *Justicia* on a regional basis (Stearn 1971). Should a world wide revision indicate the use of *Justicia* s.l. then the majority of combinations already exist under that genus in the Australian literature. A history of all species described under *Justicia* for Australia is given in Table 5, together with their status in this treatment. The only species which could not be placed with any certainty was the introduced American species, *J. carthagenensis* Jacq., usually placed near *Beloperone*, but possibly deserving discrete generic rank (Bremekamp 1948).

*Justicia* s.l. is no easier to define than *Justicia* s. str. In the broad sense the genus has usually been recognised by the anther cells being superposed and the lower anther cell having a long white basal appendage (Clarke 1900, Leonard 1958, Heine 1963, Hansen 1985) in which case *Adhatoda*, *Beloperone* and a number of other genera which lack the basal spur have been treated as separate.

By including all species of *Jacobinia*, some of which lack the basal spur, Gibson (1973) expanded *Justicia* s.l. even further to encompass plants with anther thecae "superposed, or nearly parallel on the connective, muticous, acute, or one or both calcarate at the base."

This approach is supported by Dr V. Graham (pers. comm. 1985) in her as yet unpublished review of *Justicia*. By widening *Justicia* to this extent it no longer remains possible to recognise the genus by any one character and a number of genera previously treated as distinct become submerged in it. Until a survey is conducted of the whole of tribe Justicieae it becomes difficult to predict the end point for this expanded *Justicia* concept. Already Hansen's (1985) similarly broad approach to the genus *Isoglossa* has eroded the generic limits between *Isoglossa* and *Justicia* s.l. and now the two genera and their respective subtribes, Isoglossinae and Justiciinae, appear to be separable only by the single character of presence or absence of a style channel. It has to be asked whether subtribal or even generic delimitation would remain justified for *Isoglossa* under this classification.

In Australia, where the requirement for a basal spur on the lower anther cell is used to define *Justicia* s.l. genera 23-27 would be included, but on the expanded concept of Gibson and Graham genus 28 and possibly genus 22 would also be included.

### *Ruellia*

Within *Ruellia* the only "comprehensive" studies have been those of Nees von Esenbeck (1847a) and Lindau (1895). As has been mentioned above their concepts vary. Nees recognized a number of small genera, many of which have been reinstated by Bremekamp (1948). Lindau adopted an interpretation of *Ruellia* in which 19 genera were reduced to synonymy, while 9 sections were recognized within it. Bremekamp (l.c.) considered Lindau's



Basionym	Nees (1847a)	Mueller 1867	Bentham (1868)	Author		Bremekamp	Barker (this paper)
<i>Justicia media</i> R.Br. (1810)	<i>Rostellularia media</i>	<i>J. procumbens</i>	<i>J. procumbens</i>	sect. <i>Rostellaria</i>	<i>R. pogonanthera</i>	<i>R. adscendens</i> aff. ssp. <i>clementii</i>	
<i>J. adscendens</i> R.Br. (1810)	<i>R. procumbens</i> var. f.	<i>J. procumbens</i>	<i>J. procumbens</i>	sect. <i>Rostellaria</i>	<i>R. pogonanthera</i>	<i>R. adscendens</i>	
<i>J. juncea</i> R.Br. (1810)	<i>R. juncea</i>	<i>J. procumbens</i>	<i>J. procumbens</i>	sect. <i>Rostellaria</i>	<i>R. pogonanthera</i>	<i>R. adscendens</i> var. <i>juncea</i>	
<i>J. eranthemoides</i> F. Muell. (1867)	—	—	nearest sect. <i>Rhaphidospora</i>	—	<i>Rostellularia</i>	<i>Isoglossa eranthemoides</i>	
<i>J. hygrophiloides</i> F. Muell. (1867)	—	sect. <i>Adhatoda</i>	—	sect. <i>Tyloglossa</i>	?undescribed genus	<i>Calophanoides</i> <i>hygrophiloides</i>	
<i>J. cavernarum</i> J. Muell. (1867)	—	—	close to <i>Rhaphidospora</i> <i>glabra</i> Nees	—	<i>Rostellularia</i>	<i>Rhaphidospora</i> <i>cavernarum</i>	
<i>Rostellularia</i> <i>pogonanthera</i> F. Muell. (1857)	—	? <i>J. procumbens</i>	<i>J. procumbens</i>	—	<i>R. pogonanthera</i>	<i>R. adscendens</i> ssp. <i>adscendens</i> var. <i>pogonanthera</i>	
<i>J. kempiana</i> F. Muell. (1880)	—	—	—	—	<i>Sarojusticia kempiana</i>	<i>Sarojusticia kempiana</i>	
<i>J. bonneyana</i> F. Muell. (1882)	—	—	—	—	—	<i>Rhaphidospora</i> <i>bonneyana</i>	
<i>J. pepioides</i> (Nees) T. Anders.	<i>R. pepioides</i> Nees	—	allied to <i>J. procumbens</i>	—	—	<i>Rostellularia</i> cf. <i>obtusata</i>	
INTRODUCED							
<i>J. carthagenensis</i> Jacq.	<i>Adhatoda</i> sect. <i>Tyloglossa</i>	—	<i>Beloperone</i>	<i>Justicia</i> sect. <i>Amphiscopia</i>	undescribed genus close to <i>Beloperone</i>	<i>Justicia</i> s.l.	
<i>Rostellularia</i> <i>tenella</i> Nees (1847a) (= <i>Rungia laior</i> sensu F.M. Bailey 1901)	<i>Rostellularia tenella</i> <i>R. crenulata</i> <i>Aetheiema rupestre</i>	—	sect. <i>Anisostachya</i>	<i>Micranthus rupestris</i> <i>Anisostachya tenella</i> <i>Rungia baumannii</i> <i>Phaulopsis rupestris</i>	—	<i>Anisostachya tenella</i>	

Table 5. History of the placement of native and introduced species belonging to *Justicia* s.l.

*Ruellia* to be an ‘unnatural conglomeration of unwieldy size’ and he reinstated such genera as *Leptosiphonium* F. Muell., *Dipteracanthus* Nees, *Arrhostoxylum* Nees and *Stephanophysum* Pohl while also describing a number of new genera (*Pararuellia*, *Nothoruellia*, and *Brunoniella*) for Malesia and Australia.

This narrow circumscription as defined by Bremekamp poses no difficulties in Australia. The genera recognized for Australia, *Ruellia* s.s., *Dipteracanthus* Nees, *Brunoniella* Bremek. and *Stephanophysum* Pohl, are all quite distinct. However, a critical overall revision of *Ruellia* s.l. is needed to clarify whether these distinctions are valid elsewhere. As discussed under *Brunoniella*, there is some doubt whether this is distinct from *Pararuellia*. A revision of *Ruellia* over its entire range may show the segregate genera recognized here (genera 5-8) to be worthy of only sectional or subgeneric rank. This should pose no nomenclatural difficulties as apart from the new taxa described under *Brunoniella* and *Dipteracanthus*, combinations within *Ruellia* already exist within the literature.

In the United States, Long (1970) has advocated a cautious approach to *Ruellia*. He found that crosses between two species of sect. *Dipteracanthus* (= *Dipteracanthus* Nees) were successful, whereas intersectional (or intergeneric) crosses produced partially or completely sterile hybrids, or occasional vigorous hybrids. Citing this evidence, Long (l.c.) considered that no generic revision of *Ruellia* should be attempted until more was known about the reproductive behaviour of species. He stated that the lack of genetic barriers to interspecific crossing between species sometimes placed in different genera favoured Lindau’s broad approach to *Ruellia*. However, genetic or morphological differences are not always accompanied by sterility barriers and species (or genera) circumscribed morphologically do not always coincide with groups delimited using sterility barriers as a criterion for the recognition of taxa.

In a later publication, after investigating the biosystematics of the generic type, *R. tuberosa*, and related species, Long (1976) was of the opinion that *Ruellia* s.s. would need to be expanded, but not to the broad circumscription usually adopted in America. Thus, as in *Justicia*, the final classification may be somewhere in between the two opposite approaches now in use.

The frequent presence of cleistogamous and chasmogamous flowers on the same plant in many of the species of *Ruellia* s.l. adds further difficulties to an already complex system. The two introduced species of *Ruellia* in Australia both exhibit this phenomenon and it also occurs in *Dipteracanthus* and possibly *Brunoniella*. Work by Long & Uttal (1962) in the United States documents a number of different flowering strategies for *Ruellia* and concludes that there is a predominance of cleistogamously produced offspring in natural populations; whether this is so in Australia remains to be investigated.

*Dipteracanthus* is very distinctive by the possession of club-shaped capsules, seeds with only the margins hairy and the bracteoles longer than the calyx, whereas such genera as *Brunoniella*, *Pararuellia*, *Leptosiphonium* and *Ruellia* are not markedly different from each other.

Key to genera in Australia

- 1a. Fertile stamens 4 ..... 2
- 1b. Fertile stamens 2 (sometimes accompanied by a pair of staminodes) ..... 14
- 2a. Corolla with large, 3-lobed lower lip, upper lip absent. Stamens with thick, curved bony filaments; anthers 1-celled, with stiff white hairs along sutures. [Mangrove species or cultivated escapes] . . 4. *Acanthus* p. 64
- 2b. Corolla equally 5-lobed or 2-lipped. Stamens not with thick, bony filaments: anthers 2-celled, sutures glabrous ..... 3
- 3a. Climbers or twining herbs. Calyx entire or split into 12-20 lobes. Capsule seed-bearing at base, crowned by a long stout beak. Seed excavated on one side, large and semiglobose, 1-2 per valve, collateral ..... 1. *Thunbergia* p. 40
- 3b. Herbs or shrubs, not climbing. Calyx 4-5-lobed. Capsule not crowned by a long stout beak. Seed not excavated one side, usually flattened but if small and globular, many more than 1-2 per valve ..... 4
- 4a. Corolla more or less regular ..... 5

- 4b. Corolla 2-lipped ..... 12
- 5a. Leaves without cystoliths, glandular hairy. Sepals 5, one longer and broader than other 4. Capsule with c. 60 small globular, glabrous seeds in 4 rows, these without hooks at their base. Upper leaves and bracts alternately arranged ..... 3. *Staurogyne* p. 60
- 5b. Leaves with cystoliths, without glandular hairs. Sepals 5, more or less equal in size, or 4 in 2 unequal pairs. Capsule with 2-20 large, compressed, often hairy, seeds subtended by hooks at their base. Upper leaves and bracts opposite ..... 6
- 6a. Sepals 5, more or less equal in size. Capsule with up to 20 seeds, cylindrical or club-shaped but not broadest at base. Herbs, not spiny ..... 7
- 6b. Sepals 4, in 2 unequal pairs at right angles to each other. Capsule cone-shaped, 1-2-seeded. [Corolla lobes 5, but the lowest lobe not joined for the same length as the other four, thus giving a 2-lipped appearance]. Herbs, often spiny ..... 11. *\*Barleria* p. 125
- 7a. Inflorescence a dense terminal spike of verticillately-arranged bracts. Filaments of longer pair of stamens with a line of dense, erect, long hairs throughout length ..... 9. *Hemigraphis* p. 114
- 7b. Inflorescence axillary or terminal, usually cymose, if spicate then the spike not dense. Filaments of longer pair of stamens usually glabrous, rarely (in *Brunoniella*) with short hairs basally, sometimes for whole length ..... 8
- 8a. Seeds glabrous, with angular margins, 1-2 per valve. Capsule club-shaped ..... 14. *Asystasia* p. 132
- 8b. Seeds hairy, with smooth margins, more than 1-2 per valve (although all ovules not always developing in *Brunoniella*). Capsule club-shaped or cylindrical ..... 9
- 9a. Capsule club-shaped. Seed with hairs which rapidly expand on wetting confined to margin ..... 10
- 9b. Capsule cylindrical. Seed covered all over with hairs which rapidly expand on wetting ..... 11
- 10a. Bracts shorter than calyx. Corolla red; lobes short and erect. Inflorescence an axillary, long-peduncled cyme ..... 6. *\*Stephanophysum* p. 79
- 10b. Bracts longer than calyx. Corolla blue or white; lobes spreading at right angles to throat. Inflorescence of 1-2(-3) more or less sessile, rarely long-pedicellate, flowers in the axils ..... 7. *Dipteracanthus* p. 81
- 11a. Capsule with 18-26 seeds. Stigma glabrous. Inflorescence axillary, long-pedunculate, often dichotomously branched, cyme. Large sprawling herb ..... 5. *\*Ruellia* p. 75
- 11b. Capsule 1-6-seeded. Stigma pubescent. Inflorescence a sessile axillary cluster of single long-pedicellate flowers arising from the axils, an axillary spike, or a long-pedunculate axillary cyme arising from a basal rosette of leaves. Small herbs, often prostrate ..... 8. *Brunoniella* p. 95
- 12a. Inflorescence of 3-5 dense terminal spikes crowded together. Calyx lobes 5, unequal. [Capsule more or less conical, 2-4-seeded] ..... 12. *Lepidagathis* p. 128
- 12b. Inflorescence not a dense terminal spike. Calyx lobes 5, equal ..... 13
- 13a. Flowers distinctly 2-lipped; lower corolla lip with long hairs and barred area. Capsule cylindrical, 8-24-seeded. Plants not spiny ..... 10. *Hygrophila* p. 117
- 13b. Flowers not distinctly 2-lipped; lower corolla lip without long hairs and barred area. Capsule cone-shaped, 2-4-seeded. Plants spiny ..... 11. *\*Barleria* p. 125
- 14a. Bracts spine-tipped at apex ..... 15
- 14b. Bracts not spine-tipped at apex ..... 16
- 15a. Calyx segments 5, equal. Flowers distinctly 2-lipped. Corolla tube twisted through 180°, enclosed within a bifoliate involucre of 2 slightly unequal appressed bracts. Anther cells usually inserted at unequal levels (except in *D. australis* and *D. arnhemica*). Capsule discoid, with a thickened rim and small apical beak. Seed glabrous, smooth or glochidiate ..... 19. *Dicliptera* p. 174
- 15b. Calyx segments 4, in unequal pairs. Flowers not distinctly 2-lipped. Corolla tube not twisted through 180°, not enclosed by 2 appressed bracts. Anther cells inserted at equal levels. Capsule conical. Seed covered with long hairs which expand on wetting ..... 11. *\*Barleria* p. 125
- 16a. Corolla not distinctly 2-lipped, the 5 lobes more or less equal ..... 17
- 16b. Corolla distinctly 2-lipped, the 5 lobes very unequal ..... 19
- 17a. Stamens with filaments U- or T-shaped at apex, each branch with a single anther cell at the extremity. Flowers regular, 2-5 in axillary, long-pedunculate clusters subtended by free, linear bracts. Shrubs. [Wittenoom area of Western Australia] ..... 18. *Dicladanthera* p. 171
- 17b. Stamens with filaments entire at apex, anther cells not separated laterally. Flowers somewhat irregular, in lax or dense spikes, in axillary clusters or paniculate or racemose, not subtended by a number of free linear bracts. Herbs or shrubs ..... 18

- 18a. Prostrate herbs, without cystoliths. Sepals 4, unequal, the largest segment usually toothed at apex. Stamens included; staminodes lacking. Anthers globular, dehiscing by a small flap at the base. Capsule conical, c. 28-seeded, the seeds without hooks at their base ..... 2. *Nelsonia* p. 52
- 18b. Erect herbs or shrubs, with cystoliths. Sepals 5, equal. Stamens exserted from throat; staminodes 2. Anthers linear, dehiscing longitudinally. Capsule club-shaped, 2-4-seeded, each seed with a prominent hook at its base ..... 15. *Pseuderanthemum* p. 139
- 19a. Stamens with a terminal, transverse anther cell. Corolla with upper lip 4-lobed and lower lip entire or the upper lip 2-lobed and these lobes notched and the lower lip 3-lobed. [Southern Qld].. 17. *Xerothamnella* p. 166
- 19b. Stamens with all anther cells parallel. Corolla with upper lip notched or 3-lobed ..... 20
- 20a. Anthers 1-celled. Corolla tube twisted through 180°, enclosed within a cylindrical involucre of 2 outer fused bracts with 2 smaller inner bracts fused to the outer by their midribs ..... 21. *Hypoestes* p. 195
- 20b. Anthers 2-celled. Corolla tube not twisted through 180°; not enclosed within a cylindrical involucre. .... 21
- 21a. Anther cells inserted at equal levels ..... 22
- 21b. Anther cells inserted at unequal levels ..... 23
- 22a. Corolla with upper lip 3-lobed, lower lip entire. Flowers white with deep red-purple markings. Anthers cohering and pubescent at base; filaments with long hairs on undersurface. Capsule flattened, ellipsoid, seed-bearing throughout. Seeds not flattened, 3-7 per valve. Introduced herb with entire leaves. [Darwin area] ..... 13. *\*Andrographis* p. 130
- 22b. Corolla with upper lip notched, lower lip 3-lobed. Flowers deep red-purple, rarely white with red spots in throat. Anthers not cohering at base; filaments shortly pubescent in basal half. Capsule club-shaped, seed-bearing in upper half only. Seeds flattened, 1-2 per valve. Native shrubs often with toothed leaves. [Queensland east coast] ..... 16. *Graptophyllum* p. 156
- 23a. Lower anther cell without a long white basal appendage..... 24
- 23b. Lower anther cell with a long white basal appendage ..... 26
- 24a. Inflorescence a dense terminal spike. Flowers c. 3 cm long. Seed minutely puberulent. Rachis, bracts and bracteoles without glandular hairs except for a sparse occurrence on the apex of the bracts. Introduced herb [Darwin area] ..... 28. *\*Justicia carthagenensis* p. 279
- 24b. Inflorescence long pedunculate dichotomous cymes arising in the axils. Flowers 1-2 cm long. Seed not puberulent. Rachis, bracts and bracteoles with glandular hairs ..... 25
- 25a. Bracts unequal, linear lanceolate, the larger one exceeding the calyx. Stamens exserted. Seed tuberculate. [Cape York Peninsula, Qld] ..... 20. *Peristrophe* p. 191
- 25b. Bracts equal, triangular, not exceeding the calyx. Stamens included. Seed with more or less concentrically arranged, broken ridges. [Tweed River area, NSW] ..... 22. *Isoglossa* p. 226
- 26a. Calyx lobes 5. Bracts not noticeably white margined ..... 27
- 26b. Calyx lobes 4, with or without remnant of 5th lobe. Bracts usually noticeably white-margined or (*Anisostachya*) more or less membranous with pellucid area on margin ..... 29
- 27a. Bracts and leaves indistinguishable. Inflorescence a loose terminal or axillary spike. Leaf and bract margins toothed, crenulate or rarely entire. [Dry NT and WA]. .... 25. *Sarajusticia* p. 240
- 27b. Bracts and leaves distinguishable. Inflorescence not a spike. Leaf and bract margins entire ..... 28
- 28a. Bracts conspicuous, 5-9 mm long, obcordate, not glandular hairy. Inflorescence a sessile axillary cluster of up to c. 10 flowers. Seed smooth tuberculate all over. [East coast, Qld and NSW] ..... 24. *Calophanoides* p. 235
- 28b. Bracts inconspicuous, 0.5-2 mm long, triangular or linear-lanceolate, frequently glandular hairy. Inflorescence of 1-5 flowers at the extremities of axillary, often dichotomously branched, long peduncles. Seed with sharp, conical excrescences all over. [Dry inland Qld and NSW or Rockhampton area] ..... 23. *Rhaphidospora* p. 231
- 29a. Inflorescence a dense spike of overlapping, 4-ranked bracts (cone-like), each spike 1-2 cm long, arising in pairs from the axils on slender 10-17 mm long peduncles. Seed with short white hairs all over, these expanding on wetting. Anther backs not hairy. [Once recorded near Cairns in 1891] ..... 27. *\*Anisostachya* p. 276
- 29b. Inflorescence a terminal spike with 2-ranked bracts, spikes often longer than 2 cm, often interrupted at base. Seed glabrous, tuberculate. Anther backs hairy. [All States of Australia except Victoria and Tasmania] ..... 26. *Rostellularia* p. 244

# I. THUNBERGIA Retz.

There are four species of *Thunbergia* found in Australia, three introduced and naturalised and the fourth probably native.

The first to recognise the native species was Mueller who described it as *Thunbergia arnhemica* in 1875. Subsequently, in 1882 (Mueller 1882a), he described a second species, *T. powellii*, close to *T. arnhemica* and also *T. fragrans* Roxb. of India. Later, Bailey (1901) reduced both of the Australian species to synonyms of *T. fragrans*.

Since then the only person to have looked at Australian *Thunbergia* specimens was Bremekamp who revised the Malesian species of *Thunbergia* (Bremekamp 1955b) and commented on the Australian native material subsequently (Bremekamp 1964). He regarded *T. arnhemica* as a distinct species and a discussion of his concepts in the genus will be found under that species.

Of the other three introduced species, *T. alata* and *T. grandiflora* are commonly cultivated, but have in places along the north-eastern coast of Australia become naturalised and regarded as weeds. *T. aff. laurifolia* has only recently been recorded as an escape in the Cairns area.

**Thunbergia** Retz., Physiogr. Salsk. Handl. 1 (3) (1780) 163, nom.cons.; Benth., Fl. Austral. 4 (1868) 542; Clarke in Hook. f., Fl. Brit. India 4 (1885) 390; Ridley, Fl. Malay Penins. 2 (1923) 556.

*Type species: T. capensis* Retz. (South Africa)

Twining or vigorous climbers; without cystoliths. *Branches* more or less terete to 4-angled, sometimes longitudinally grooved. *Leaves* and *flower subtending bracts* petiolate, simple, usually with cordate bases, becoming smaller apically. *Inflorescence* axillary with a pair of pedicellate flowers per node, usually these combined into terminal racemes with 2-4 flowers per node. *Bracteoles* 2, erect, enclosing corolla tube and usually persisting in fruit, free or fused along one side, usually with a line of white intertwined eglandular hairs along margin, elsewhere glabrous or pubescent. *Calyx* much smaller than bracteoles and corolla, entire or with 12-20 acute lobes, glabrous or pubescent, sometimes with cyathiform nectaries externally. *Corolla* contorted in bud, tube usually just exceeding bracteoles, constricted or not at base, sometimes with a ring of hairs internally at point of insertion of filaments; limb oblique with 5 subequal lobes. *Stamens* 4, often didynamous, included in tube; filaments narrow or broad; anther cells awned or not, equally inserted, sometimes with long eglandular hairs along length; pollen sometimes spiny. *Disc* annular, enclosing ovary at base. *Ovary* with 2 collateral ovules per cell, glabrous or pubescent; style shorter or slightly longer than tube; stigma cup-shaped, entire or divided into two, sometimes unequal, lobes. *Capsule* woody, with expanded seed-bearing portion at base and long apical beak, up to 4-seeded. *Seeds* with a smooth hollow on one side, rim and sometimes convex surface with reticulate ridges, these sometimes only in lower half. Fig. 1 K-N.

## Distribution

This genus is mostly African, consisting of c. 90 species. A number of species have pantropical distributions through frequent introduction. In Australia it is found in tropical regions of Queensland, Northern Territory and Western Australia, with the cultivated *T. alata* extending into more southern areas.

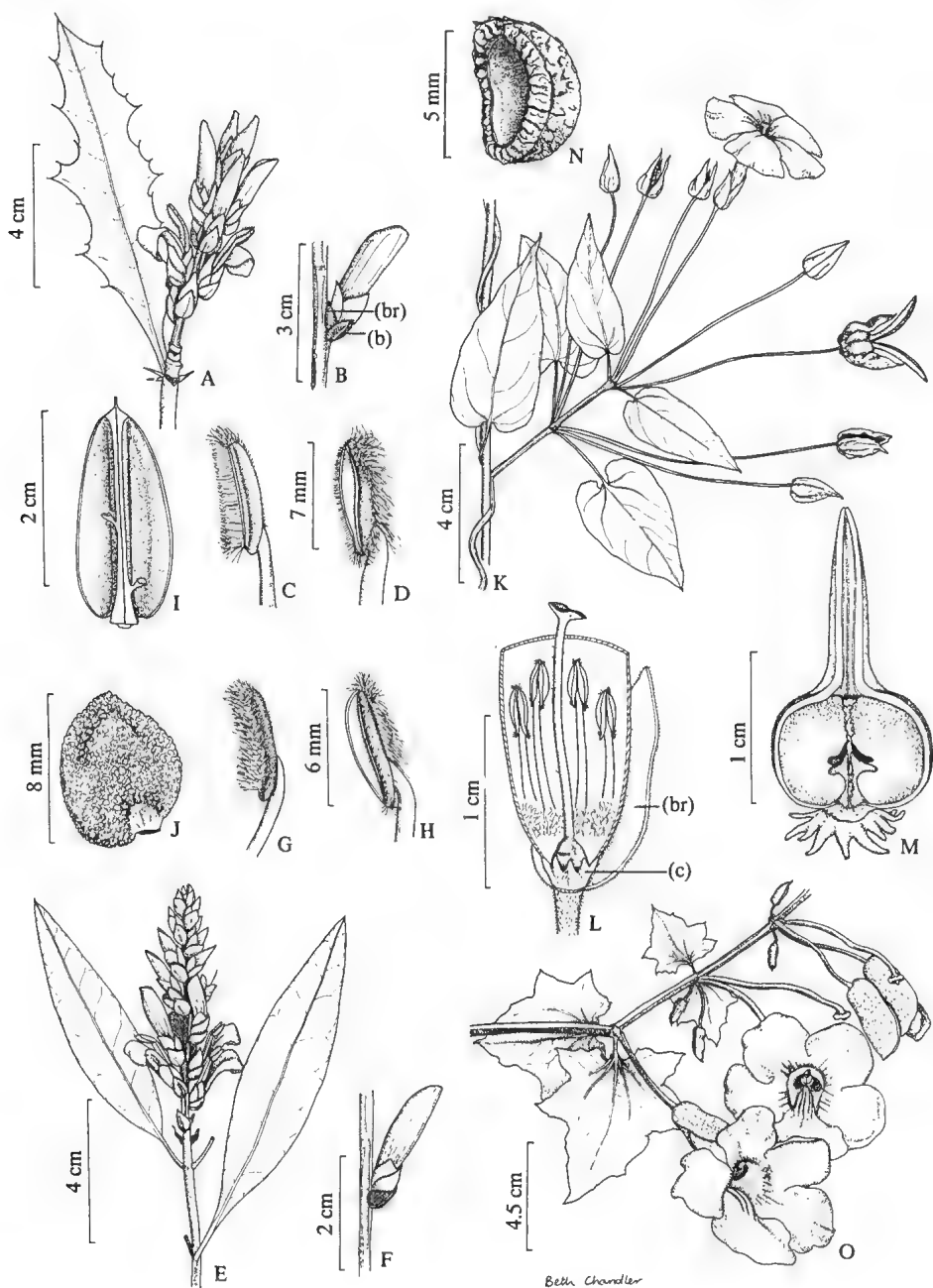


Fig. 1. A-D, I, *J. Acanthus ilicifolius* L. A, leaf and spike; B, single bud with bract (b), bracteole (br) and calyx (Wightman 82); C, D, pair of stamens with anthers showing hair distribution (Smith 11679); I, half capsule showing seed-bearing hooks; J, seed (Gill M1). E-H, *Acanthus ebracteatus* Vahl. ssp. *ebarbatus* R.M. Barker. E, leaves and spike; F, single bud with bract (b) and calyx (Wells DNA 013670); G, H, pair of stamens showing hair distribution on anthers (Martensz & Schodde 743). K-N, *Thunbergia arnhemica* F. Muell. K, habit (Parker 703); L, opened flower showing longitudinal section of corolla tube, calyx (c) and bracteole (br) (Kenneally 3944A); M, half capsule with persistent calyx (c) at base; N, seed (George 14490). O, *T. grandiflora* Roxb., habit (Frampton BRI 251898).

**Key to species of *Thunbergia* in Australia.**

- 1a. Petiole winged. Calyx c. 12-lobed, with glandular hairs. Stigma 2-lobed. Flowers orange or yellow, rarely white, often with black throat ..... 2. *T. alata*
- 1b. Petiole not winged. Calyx entire or 11-20 lobed, without glandular hairs although sessile glands often present. Stigma entire or 2-lobed. Flowers white or blue ..... 2
- 2a. Flowers axillary, white. Bracteoles without cyathiform glands. Anther cells with short sparse hairs on their backs and without long curved awns at their base ..... 1. *T. arnhemica*
- 2b. Flowers in terminal racemes, blue. Bracteoles with cyathiform glands. Anther cells with long intertwined hairs all over and long curved awns at their base ..... 3
- 3a. Leaves ovate, glabrous. Bracteoles glabrous ..... 4. *T. aff. laurifolia*
- 3b. Leaves palmatilobed, pubescent. Bracteoles with velvety indumentum ..... 3. *T. grandiflora*

1. *T. arnhemica* F. Muell., *Fragm. Phyt. Austral.* 9 (1875) 73; F. Muell., *Syst. Census Austral. Pl.* (1882) 99; F. Muell., *Sec. Syst. Census Austral. Pl.* (1889) 167; Bremekamp, *Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk. Tweede Sect.* 50 (1955) 81; J. Green, *Census Vasc. Pl. W. Austral.* (1981) 95; R.M. & W.R. Barker in Morley & Toelken, *Fl. Pl. Austral.* (1983) 283, fig. 71A.

*Holotype*: Schultz 17, s. dat. Port Darwin (MEL 602002).

*T. powellii* F. Muell., *Syst. Census Austral. Pl.* (1882) 99; F. Muell., *South. Sci. Rec.* (1882); F. Muell., *Sec. Syst. Census Austral. Pl.* (1889) 167.

*Lectotype here designated*: Powell 22, 1881, Goode Island (MEL 602005); *Syntypes*: Powell 1, s. dat. Goode Island (MEL); Powell s.n., 14.vi.1882. Goode Island (MEL 602003, MEL 602004); Powell s.n., 1882, Goode Island (MEL 602007).

*T. fragrans* auctt. non Roxb.: Clarke in Hook. f., *Fl. Brit. India* 4 (1885) 390; F.M. Bailey, *Qld Fl.* 4 (1901) 1141; F.M. Bailey, *Weeds & Poisonous Pl. Qld* (1906) 136, f. 234.

*T. fragrans* Roxb. var. *javanica* (Gaertn. f.) C.B. Clarke, *J. Asiat. Soc. Bengal* 74 (1907) 632 p.p. (only as to occurrence in N. Australia).

?*T. hastata* Decne., *Nouv. Ann. Mus. Hist. Nat.* 3 (1834) 388.

*Types* (n.v.) from Timor. (P, L, K, G according to Bremekamp, 1955).

?*T. thespesiifolia* Bremek., *Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk. Tweede Sect.* 50 (1955) 81.

*Holotype*: Grevenstuk 236, s. dat., Sôemba, Rendi Menili (BO: n.v.).

?*T. papuana* Bremek., *Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk. Tweede Sect.* 50 (1955) 83

*Syntypes*: Brass 3594, s. dat. Laloki River, Rona, Papua (BO, BM, NY: n.v.).

Herbaceous, ?perennial climber, usually with sparse eglandular hairs on all parts. *Branches* obscurely 4-angled. *Leaves* with unwinged, 1.0-2.8 cm long petiole, blade ovate, with cordate base, broadly or narrowly hastate, the former 3-7 x 1.8-4 cm, the latter 3-7.5 x 1-3.5 cm, crenulate or irregularly toothed, acute. *Inflorescence* axillary, with 1-2 long-pedicellate flowers per axil. *Pedicel* of mature flowers 4.5-14 cm long, shorter in bud, usually far exceeding petiole of subtending leafy bract. *Bracteoles* free, margins appressed in bud, persisting or not in fruit, ovate-lanceolate, 1.5-2.0 cm long, with short, sparse to moderately dense, eglandular hairs all over outer surface, with a dense line of intertwined white hairs on margins of inner surface. *Calyx* somewhat unequally (8) 12-16 (-20)-lobed, persistent in fruit, glabrous or with sessile (nectariferous) glands outside at base and around margins of lobes, sometimes mixed with eglandular hairs all over. *Corolla* white, tube c. 2 cm long, enclosing anthers and sometimes stigma, sometimes constricted near base at point of insertion of filaments, then usually with hairs in clumps on inner surface, these rarely forming a ring, sometimes, if not constricted and glabrous on outer surface, with sparse mixture of glandular and eglandular hairs; lobes c. 2 cm long, sometimes with eglandular hairs on margins. *Stamens* with filaments 0.2-0.3 mm wide, glabrous, shorter ones 1.5-5.5 mm long, longer ones 3.5-9 mm long; connectives sometimes



extended above anthers into mucro; anthers with cells 2.5-3.5 mm long, divergent, narrowed into short point (spur) 0.1-0.3 mm long at base, rarely (holotype), spurs extended to 0.6 mm long, cells sometimes with a few hairs at apex and base; pollen spiny. *Disc* annular. *Ovary* glabrous; style exceeding corolla tube by 2-4 mm, or about same length as tube; stigma 2 lobed, appressed to form shallow or deep cup. *Capsule* more or less glabrous or with sparse to dense eglandular hairs all over, seed-bearing base 0.8-1.0 x 1.2 cm, beak 1.5-1.6 cm long. *Seed* c. 6 mm diameter, with crested ridges confined to rim, convex surface smooth with depressed areas. Fig. 1, K-N.

### Typification

#### 1. *T. arnhemica* F. Muell.

There is only one sheet of *T. arnhemica* F. Muell. in MEL which qualifies as type material. The dissected flower has stamens with long basal awns as described in Mueller's original description (see below).

#### 2. *T. powellii* F. Muell.

There are five sheets in MEL which might qualify for lectotypification of *T. powellii*. All of the material was collected by Mr Powell from Goode Island and Mueller's description of the species and intention to publish the species as new was announced in February 1882 (Mueller 1882a). Two of the collections (MEL 602003 and MEL 602004) must have been received subsequent to this as they bear the date 14.vi.1882, while a third sheet (MEL 602007) is dated 1882, without a month, and consists of seeds and capsules only. It is possibly part of *Powell 1* which refers to seeds but has none on the sheet. The other two collections bear Powell's numbers 1 and 22, the latter bearing the date 1881 and the former no date at all. Mueller's (1882a) short diagnosis in Southern Science Record must have been based on these two collections.

The actual publication of *T. powellii* did not occur until late 1882 in the Systematic Census of Australian Plants (Mueller 1882) where the combination was made, but nothing further given apart from the location of his earlier note. At this stage Mueller had presumably seen all five specimens. However, because the original diagnosis was based on two specimens one of these must be the lectotype. Of these *Powell 22* is selected as lectotype as it contains flowers (dissected by Mueller), capsules and seeds. *Powell 1* has much better flowering material, but lacks any fruiting specimens even though the accompanying label mentions that seed is present (these may be the capsules and seed of MEL 602007).

### Distribution

*T. arnhemica* F. Muell. is found in northern tropical Australia and, depending on species concepts in the genus (see below), may extend to New Guinea, Timor and possibly Sandalwood Islands. Fig. 2.

### Ecology

The Western Australian specimens are all from loam on the edges of vine thicket. Other collections have come from the edges of dry monsoon forest and rainforest, and a number have been found twining in grasses, on secondary vegetation or on roadside weeds. The fact that most collections are from the edges of thick vegetation may indicate a need for high light intensity or simply ease of collection. Flowering specimens have most frequently been collected from January to April in all states implying, as suggested by J. Clarkson (pers. comm 6.x.1982), that flowering occurs "soon after the wet season", when access to most areas where it occurs is difficult.

## Notes

1. Affinities of the single *Thunbergia* species native to Australia

Bremekamp revised the Malesian species of *Thunbergia* in 1955. Within his subgenus *Adelphia* where botanists had previously only recognised *T. fragrans* Roxb., with a number of varieties, he recognised 30 new species in a total of 35. He claimed that "... a detailed study revealed that the variability is in *Thunbergia* ... discontinuous, and that the various forms are not indiscriminately mixed, but at least most of them are confined to comparatively small areas, in which, however, they may occur in great abundance. Moreover, between the *Thunbergia* species of the subgenus *Adelphia* nowhere intermediate forms could be detected".

The main characters used to subdivide the subgenus *Adelphia* were seed coat, relative lengths of the filaments and calyx teeth number. Species from western Malesia (including India, Ceylon and Indo-China) were reputed to have a smooth ventral seed surface while those from eastern Malesia (including Australia) had a ribbed or carunculate ventral surface; Australian and New Guinea material seen for this work conforms with this regional distinction.

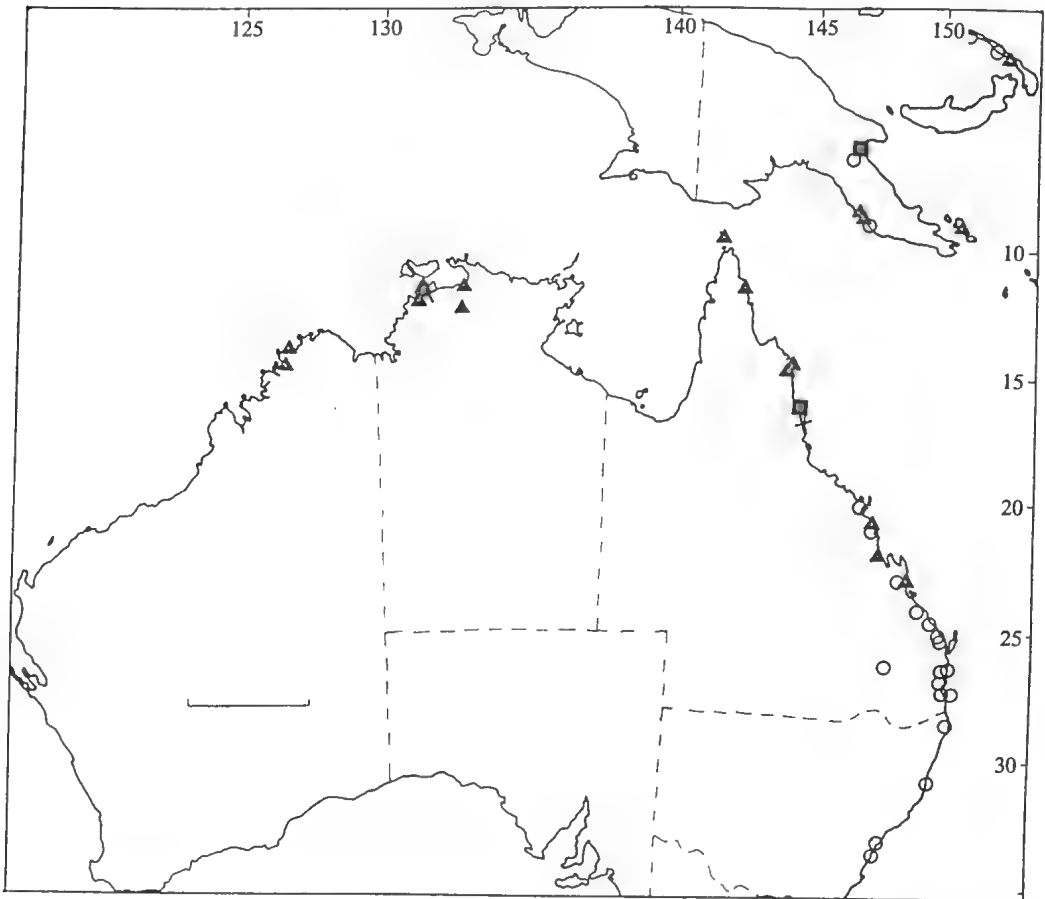


Fig. 2. Distribution of *Thunbergia* species in Australia and Papua New Guinea. (▲ *T. arnhemica*, ○ *T. alata*, + *T. grandiflora*, ■ *T. aff. laurifolia*).

Bremekamp also documented that specimens from the Lesser Sunda Islands, New Guinea and tropical Australia had stamens with shorter filaments 7-8.5 mm long and the longer ones 10.5-16 mm long. However, in Australian material (with one exception: see Note 3b) it has been found that the shorter filaments are 1.5-5.5 mm long while the longer ones are 3.5-9 mm long. Thus, in neither case do the filaments reach the lengths attributed to them by Bremekamp. Using these measurements in Bremekamp's key, Australian material would come close to *T. batjanensis* Bremek. from the northern Moluccas. It differs from it by the larger number of calyx teeth and the exerted stigma.

In a later paper, Bremekamp (1964) claimed that the Australian species was distinct from all other material, except *T. thespesiifolia* Bremek. of the Sandalwood Islands in the Timor Sea, by the possession of short spurs (sometimes referred to as a mucro, Bremekamp 1955) at the base of the anther cells. These short spurs are present on all Australian specimens, but Bremekamp does not mention how one can distinguish between *T. thespesiifolia* and the Australian species. From his original description of the former (Bremekamp 1955) there would appear to be a difference in filament lengths. However, as already stated, this has not been found to be a very reliable character and as all other characters seem to fall within the range of variability of Australian specimens, it may prove that the two are conspecific.

Other characteristics which Bremekamp (1955b) used to separate species include the nature of the connective which is sometimes extended into a mucro, the nature of the style and stigma (whether included or exerted), the calyx teeth number and the pedicel and petiole lengths. In each of these characters Bremekamp adopted narrow ranges of variation for his species, but the Australian and New Guinea specimens have been found to have a much wider range. For instance, in some Australian and most New Guinea specimens the connective is extended into a sharp mucro; in most Australian specimens the stigma is exerted (this is difficult to judge in the case of the New Guinea specimens, but it mostly appears to be about level with the opening of the throat); the calyx teeth number is usually about 16, but may be as low as 8 or as high as 20, and the anthers of Australian specimens are sometimes shortly hairy at the base and apex, but not always.

Bremekamp (l.c.) placed the New Guinea material in one species, *T. papuana* distinguished by having a mucro at the top of the anther cells, (i.e. additional to the mucro sometimes occurring on the connective and differing in this character from Australian material), and by its glabrous capsules and included stigmas. Of the eight specimens I have seen from New Guinea, only *Henty & Lelean NGF 41899* had anthers which possessed a mucro at the apex of each cell (although the connective was sometimes extended into a long mucro in other specimens), but in this collection the stigma was exerted. As with the Australian specimens the New Guinea material has been found to have filaments shorter than that recorded by Bremekamp in his revision.

As neither the Australian nor the New Guinea material seems to fit Bremekamp's narrow species concept, or the range of variation attributed to them by Bremekamp, this casts some doubt on his classification. It is probable that many of his species have not been adequately defined, based as almost half (16) of them are on only 1 or 2 specimens, with a further 10 species based on 10 or less collections. Even with the number of Australian and New Guinea specimens available for this revision (28), there was a lack of good flowering material; often there were only 1 or 2 flowers (if any) present per collection, insufficient to establish variation in the floral characteristics of a population.

In the light of these comments, a revision of the subgenus *Adelphia* is required throughout Malesia to test the status of Bremekamp's 35 species. If his classification does stand, then it is likely that Australian material will need to be assigned to several different taxa to encompass the variation encountered (Note 3). At present I have chosen to interpret the variation as part of that of a single variable species (possibly encompassing clinal variation in Australia at least: Note 3a) the choice of name of which is discussed below.

Amongst the Australian material the type specimen of *T. arnhemica* from Darwin is exceptional in possessing long basal anther spurs. By Bremekamp's classification this would make the specimen intermediate between subgenus *Parahexacentris* and subgenus *Adelphia*, as the latter lacks spurs ("awns"). It could also be argued that the rest of the Australian material and the Sandalwood Island species, by the presence of the short spurs at the base of the anthers, would also occupy a similar position.

## 2. Choice of name for the Australian native species

There seems to be a choice of four names for the Australian native *Thunbergia*. Of these *T. fragrans* Roxb., a name based on an Indian type, has been used in the past, but as discussed under the typification of that species (p. 52), if one accepts the Roxburgh drawing as lectotype of the species, Australian material differs in a number of possibly trivial characters. Thus *T. fragrans* has shorter pedicels, solitary flowers, 3-toothed corolla lobes and included stigmas.

The other species which needs to be investigated is *T. hastata* Decne. from Timor, of which I have not seen type material. Its name arises from the possession of hastate leaves, a characteristic which occurs in some Queensland specimens (see Note 3a), but not in those from Western Australia. Bremekamp (1955) considered it to be distinct from *T. arnhemica* F. Muell. by its shorter petioles and pedicels, wider calyx lobes, slightly longer tube and throat of the corolla and more exserted stigmas (4 mm compared with 1 mm). The only one of these character differences which seems to be confirmed is pedicel length, 3.5 cm in *T. hastata* according to Bremekamp, but 4.5-14 cm in Australian material (for pedicels supporting mature flowers). In addition Bremekamp (1964) noted that *T. hastata* lacks the short spurs at the base of the anther cells, characteristic of the Australian species.

Until subgenus *Adelphia* (*T. fragrans* s.l.) can be revised throughout its range, the Australian and possibly some New Guinea material is best assigned to *T. arnhemica* F. Muell., the first name to be applied to purely Australian material. The other Australian species name, *T. powellii* F. Muell., only needs to be applied if more than one taxon is recognised in Australia, in which case Queensland specimens would be referable to it: Western Australian specimens would be referred to *T. arnhemica*. These would perhaps be more appropriately recognised at an infraspecific level (see Note 3a).

## 3. Variation in *T. arnhemica*

a. *T. arnhemica* is a highly variable species in characters such as calyx teeth number, number of flowers per axil, filament length, length of style (in relation to whether the stigma is included or exserted), presence or absence of hairs in the corolla tube and pubescence of anthers and capsules. Despite this, there is a tendency for Queensland material to possess hastate leaves and be more pubescent than Western Australian material which has ovate leaves with a cordate base. In addition Queensland specimens frequently have some form of pubescence in the corolla tube at the point of insertion of the stamens, a characteristic often, but not always, lacking in Western Australian material. If these were the only specimens to be dealt with, it would probably be possible to recognise two vicarious infraspecific taxa.

However, the specimens from Northern Territory are more or less intermediate between the two groups and there is difficulty in assigning them to a particular group. With the lack of understanding of population variation, the paucity of good flowering material from all states, and the apparently close relationship with taxa outside Australia, it was considered inadvisable to recognise infraspecific taxa.

It is possible to propose, in line with Bremekamp (1955b), that each morphological type of *Thunbergia* in Australia is sufficiently isolated such that a number of different taxa are present. Alternatively, the populations could have arisen from geologically recent introductions from

various parts of Malesia, although if this was the case it would be expected that specimens could be assigned to Bremekamp's presently recognised taxa; this is not the case as discussed in Note 1.

Whatever the cause of the variation in Australian material, it is unlikely that any pattern will emerge without field work and population collections. The task may prove difficult judging by the paucity of collections already in Australian herbaria. It is rare in the Northern Territory (pers. obs. and C. Dunlop pers. comm.); in Queensland J. Clarkson (pers. comm. 6.x.1982) considered it "could be quite widespread on Cape York" but suggested it was not often collected because it flowered just after the wet season.

b. One of the specimens seen by Bremekamp (1964) from Australia (*Anon. s.n.*, AD 96307247) possesses the long stamens attributed to the Australian specimens (shorter-filaments 6.5 mm, longer-filaments 12.5 mm) by Bremekamp in his 1955 work. However, the longer pair of stamens is in fact exerted from the tube, a characteristic not noted before in Australian material. The stigma is exerted, the anthers of the longer pair of stamens possess a mucro at the apex of the connective, there is a short spur at the base of each cell, and the calyx lobes seem to be fewer (c. 10) and shorter than usual. None of the other Australian specimens exhibit this combination of characters.

### *Specimens examined*

QUEENSLAND: MAINLAND: *Armstrong s.n.*, iv.1884, St. Lawrence, Broadsound (MEL 100860), *Blake* 23445, 20.v.1970, Isabella Falls (BRI, NSW); *Clarkson* 2184, 8.vi.1978, S end of Temple Bay, creek between Glennie and Hunter Inlets (BRI); *Dietrich* 2357, i.1865, Gladstone, near Keppel Bay (MEL); *Persieh* 557 and 642, 1882, Endeavour River (MEL); *Stanley* 7842 & *Ross*, 18.xi.1978, Mackay (BRI). TORRES STRAIT ISLANDS: *Powell* 1, s. dat. Goode Island (MEL 602006); *Powell s.n.*, 14.vi.1882, Goode Island (MEL 602004); *Powell* 22, 1881, Goode Island (MEL 602005); *Powell s.n.*, 1882, Goode Island, (MEL 602007).

NORTHERN TERRITORY: *Byrnes* 1372, 20.ii.1969, 2 m S UDP Falls, Sth Alligator River (BRI); *Byrnes* 2450, 5.i.1972, South Alligator River (CANB, NT); *Must* 1354, 30.iii.1976, Berry Springs (BRI, CANB); *Parker* 703, 21.ii.1977, Berry Springs (CANB); *Schultz* 17, s. dat., Port Darwin (MEL: holotype of *T. arnhemica*); *Tate s.n.*, ii.1882, Palmerston, Arnhem Land (AD 96307244).

WESTERN AUSTRALIA: *George* 12370, 17.vii.1974, Bushfire Hill, Prince Regent River Reserve (PERTH); *George* 14490, 22.iv.1977, 30 km N of Mitchell Plateau Mining Camp (CANB, NSW, PERTH); *Kenneally* 6990, 4.ii.1979, Lone Dingo vine thicket, Mitchell Plateau (PERTH); *Kenneally* 7098, 8.ii.1979, Crusher vine thicket, 8 km S of Amax Base Camp, Mitchell Plateau (AD, PERTH); *Kenneally* 8110, 25.iv.1982, Lone Dingo, c. 25 km NNW of mining camp site, Mitchell Plateau, (AD, PERTH).

AUSTRALIA WITHOUT LOCALITY: *Anon. s.n.*, s. dat. N. Australia (AD 96307247, AD 96307246).

PAPUA NEW GUINEA: *Brass* 23716, 31.vii.1953, Bininguni Camp, Gwariu River, Milne Bay District (LAE); *Coode, Croyley & Katik* NGF29793, 7.ii.1967, near Namatanai, New Ireland (LAE); *Henry & Lelean* NGF41899, 18.ii.1969, Cape Rodney-Marshall Lagoon Road, Abau subdistrict (LAE); *Streimann & Kairo* LAE51576, 7.v.1971, Kuriva Forestry area, nr Veimauri River, Port Moresby subdistrict (LAE); *Streimann & Lelean* LAE52569, 22.x.1971, Salamo, Fergusson Island, Milne Bay District (LAE); *van Royen* 6618, 5.ix.1961, road from Rabaul to Keravat, New Britain (LAE); *van Royen* NGF16063, 29.i.1963, Rouna Falls, Central District (LAE); *Womersley* NGF43892, 27.ii.1972, foothills inland from Brown River Forest Plantation, Port Moresby subdistrict (LAE); *Womersley s.n.*, iv.1960, without locality (LAE, sheet no. 29297).

2. *Thunbergia alata* Boj. ex Sims, Bot. Mag. 52 (1825) t. 2591; Benth., Fl. Austral. 4 (1868) 542; F.M. Bailey, Qld Fl. 4 (1901) 1142; F.M. Bailey, Compr. Cat. Qld Pl. (1913) 368; F.M. Bailey, Weeds & Poisonous Pl. Qld (1906) 136, f. 235; Bremek., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. 50 (1955) 41; Kleinschmidt & Johnson, Weeds of Qld (1979) 261.

*Type*: based on plants grown from seed from Mauritius in England and then sent to J. Sims, the editor of Curtis's Botanical Magazine of that time. (Herbarium unknown).

Herbaceous perennial twiner. *Leaves* with winged, 1.5-4.3 cm long petiole, blade more or less hastate or sagittate, 2-7 x 1-4.5 cm, more or less entire to irregularly toothed, acute; both surfaces strigose. *Inflorescences* solitary, axillary. *Pedicel* 3.2-6 cm long, longer than petiole of subtending leaf bract, with long intertwined eglandular hairs. *Bracteoles* fused along one side, corolla emerging from the other, ovate-lanceolate, 1.4-1.5 cm long, eglandular hairs on outer surface. *Calyx* acutely c. 12-lobed, with glandular and eglandular hairs externally, nectariferous. *Corolla* orange or yellow, rarely white, usually with black centre; tube 1.4-2.2 cm long, constricted at base, expanded above into a throat containing stigma and stamens, inner surface with stout, multicellular, glandular hairs; lobes spreading, c. 1-1.5 cm long. *Stamens*: anther cells of longer pair and upper cell of shorter pair with line of multicellular capitate hairs along sutures and hooked awns at base; lower anther cell of smaller pair of stamens without awn but with thick tuft of hairs at base; pollen not spiny. *Ovary* glabrous; stigma included, slightly longer than stamens, 2-lobed, lobes half-cup shaped, unequal. *Capsule* with dense cover of fine, erect eglandular hairs on outer surface, seed-bearing base 0.5-0.7 cm long, beak 0.9-1.5 cm long. *Seed* c. 4 mm diameter with reticulate ridges on convex surface.

### Distribution

This species, which is a native of East and South Africa, is now cultivated and often naturalised in all the warmer parts of the world. In Australia *T. alata* is naturalised in coastal areas of southern Queensland and northern New South Wales and is extensively cultivated in southern states. Its introduction occurred in the last century, the oldest known collection being that by Griffith in 1881. In New Guinea it has also become widely naturalised. Fig. 2.

### Ecology

*T. alata* has been recorded from waste ground, from trees on road-sides, from dune scrub and from "fringing forest". It flowers all year round.

### Note

Though *T. alata* is extensively cultivated in southern states it usually sets little seed indicating either a lack of pollinators, or a requirement for warmer temperatures for seed development. In support of the latter are the few capsules with viable seeds usually produced in the warmer months of the year in Adelaide gardens (personal observation).

### Specimens examined

NEW SOUTH WALES: *Anon. s.n.*, 1907, Lismore (MEL 100863); *Coveny 6108 & Wilson*, 18.iii.1975, Royal National Park, waterfall (NSW); *Johnson s.n.*, v.1964, Devlin's Ck, N. Epping (NSW 151898); *Johnson 7737*, i.1974, Hat Head (NSW); *McBarron 14086*, 26.iii.1967, Casula Rd, Casula (NSW).

QUEENSLAND: *Blake 2562*, 30.viii.1931, between Pialba and Maryborough (BRI); *Blake 7037 & Miss Middleton*, 22.viii.1934, Buderim (BRI); *Everist s.n.*, vi.1974, Stradbroke Island (BRI 226413); *Hamilton Kenny s.n.*, iv.1912, Sherwood Rlwy Stn (BRI 282693); *Kleinschmidt 293 & 294*, 14.iv.1970, Greenleaves Nursery, Mt Gravatt (BRI); *Griffiths 137*, xi.1881, Pioneer River, Mackay (MEL); *Johnson s.n.*, 24.v.1951, E. Ithaca Ck, WNW of Brisbane (NSW); *McDonald 3275*, 17.iv.1980, Bulburin State Forest, Creek crossing on Granite Ck Rd, just W of junction of Pine and Granite Creeks (BRI); *McKie 2118*, 6.x.1936, Maroochy River, Yandina (BRI); *Michael 932*, s. dat. Proserpine (BRI); *Sampson s.n.*, 2.i.1974, Caboolture, off Morayfield Rd (BRI 164356); *Simmonds s.n.*, 10.ix.1887, Belmont (Brisbane) (BRI 114472); *Stanley 78142 & Ross*, 18.xi.1978, Kolan River Crossing on Bundaberg-Rosedale Rd (BRI); *Stanley 78243 & Ross*, 18.xi.1978, Mackay (BRI); *Thozet 456*, s. dat. Rockhampton (MEL); *White s.n.*, 1912, Burdekin Mt (BRI 282694).

AUSTRALIA WITHOUT LOCALITY: *Anon (?Bailey) s.n.*, s. dat. (BRI 282695).

PAPUA NEW GUINEA: *Benjamin & Wiakabu LAE 67847*, 24.v.1977, Koitabu Stn, Port Moresby subdistrict (LAE); *Coode, Cropley & Katik NGF 29807*, 11.ii.1967, Kavieng, New Ireland (LAE); *Millar NGF 14547*, 11.vi.1962, Rockpile deposited in 1956, Bulolo, Morobe District (LAE); *Pulsford UPNG 142*, 10.ix.1969, Sogeri Estate Plantation, Port Moresby subdistrict (LAE); *Rigby 3*, 10.x.1961, Nanatonai, New Ireland (LAE).

3. *Thunbergia grandiflora* (Roxb. ex Rottler) Roxb.\*, Hort. Beng. (1814) 45; Lodd., Bot. Cab. t. 324 (1819); Roxb. in Edgeworth, Bot. Reg. 6 (1820) t. 495; Roxb., Fl. Indica 3 (1832) 34; Nees in A. DC., Prodr. 11 (1847) 54 p.p.; T.Anders., J. Linn. Soc. Bot. 9 (1867) 447; Bremek., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. 50 (1955) 45; Kleinschmidt & Johnson, Weeds of Qld (1979) 262. — *Flemingia grandiflora* Roxb. ex Rottler, Ges. Naturf. Freunde Berlin Neue Schriften 4 (1803) 202.

*Type*: India, collector and specimen uncertain (see Typification).

Vigorous woody vine, stoloniferous. *Branches* 4-angled, often grooved longitudinally. *Leaves* with unwinged, 1.5-6.0 cm long petiole, shortly palmatilobed, 3.4-12 x 3.5-14 cm, becoming progressively smaller and bract-like in uppermost parts particularly subtending inflorescences, cordate, acute, hairy on both surfaces, 5-7 main veins. *Inflorescence* a terminal raceme with 2-4 flowers per node. *Rachis* with eglandular hairs and large cyathiform glands. *Pedice*l 2-3 cm long, with a few cyathiform glands at apex. *Bracteoles* fused along one side, c. 3 cm long at maturity, with velvety eglandular indumentum mixed with sparse, large, cyathiform glands (black dots) on outer surface. *Calyx* an entire ring, persistent in fruit, glandular all over, glands obscured by stiff, erect, eglandular hairs on outer surface. *Corolla* pale to mid-blue, darker towards throat, whitish to cream in throat with darker striations; tube 3-4 cm long, constricted at base around ovary, constricted portion striated and with ring of dense, stiff, eglandular hairs inside at point of insertion of filaments; lobes spreading, c. 2 cm long. *Stamens* with broad (1.5-2 mm wide) filaments; anthers either with 3 mm long hooked awns at base of each cell (*White 8788*) or one pair of stamens with much shorter (0.5 mm long) awns on lower anther cell (*Frampton BRI 251897*), all cells with long multicellular, branched eglandular hairs along suture and around apex of awn; pollen not spiny. *Disc* hard, surrounding basal half of ovary. *Ovary* with stiff, eglandular hairs; stigma not exerted, entire, cupshaped. *Capsule* (few seen) with eglandular hairs all over outer surface mixed with short glands, seed-bearing base 1.0-1.2 cm long, beak 1.6-2.0 cm long. *Seed* with reticulate ridges, c. 8 mm diameter (only 2 seen). Fig. 1, O.

### Typification

A number of specimens were seen from Kew which could qualify for lectotypification of the species, but it was considered that this was better left to a revision of the genus in the Indian area, particularly as there is doubt on whether the Kew specimens can be considered types.

### Distribution

*T. grandiflora* is a native of India and has been cultivated and sometimes naturalised in all the tropical regions of the world. In Australia all collections which were not cultivated came from the Cairns-Innisfail area of Queensland. Fig. 2.

### Ecology

*T. grandiflora* is a vigorous climber rapidly smothering other vegetation and is sometimes regarded as a weed where it has escaped from cultivation. In far North Queensland where it might be expected to pose a problem there was apparently, in 1982, no concern about the species spreading, and it was in fact not well known by local agricultural extension officers (J. Clarkson pers. comm. 6.x.1982). A more recent communication from John Clarkson (18.vi.1985) suggests that the plant may now be causing problems in the Johnstone Shire.

\*While the name of this species is not in doubt its author and place of publication is. It is possible that *Flemingia grandiflora* is illegitimate in which case the species would be attributable to Roxburgh. However the publication which contains the first valid description (Roxb. 1814 or 1820) is arguable. This matter is presently being investigated with Dr Brummitt of K.



### Notes

1. Bremekamp (1955b) recognised a new variety of *T. grandiflora*, var. *spaniotricha*, which differs from var. *grandiflora* by having glabrous lower leaf surfaces and a white or violet-blue corolla. On this basis Australian material, which has hairy lower leaf surfaces, falls within var. *grandiflora*. This variety is reputed to have (Camerloher in Bremekamp l.c.) flowers which are self incompatible.

2. The large cyathiform glands on the pedicel and bracts have been postulated by Camerloher (cited in Long 1970) to be a means of preventing the activity of nectar "thieves". The usual pollinators of this plant are *Xylocopa* bees which often circumvent the normal pollination procedure by chewing a hole through the base of the corolla tube. In this case, however, ants are attracted to the extra-floral nectaries on the bracts and pedicels and chase other insects away. The only access to the nectar in the corolla tube for the *Xylocopa* bees becomes the conventional way.

### Specimens examined

NORTHERN TERRITORY: *R.M. Barker 401*, 3.v.1983. Vacant block, corner Manton and Wood St, Darwin (AD).

QUEENSLAND: *Everist 5084*, 16.v.1952. About 8 miles from Innisfail on Cairns Rd (BRI — 2 sheets); *Frampton s.n.*, i.1980, Babinda (BRI 251897 and 251898); *Hawton s.n.*, 6.vi.1972, South Johnstone (BRI 138736); *Kleinschmidt 290*, 14.iv.1970, Greenleaves Nursery, Mt Gravatt (BRI); *Mulgrave Shire Council s.n.*, 23.i.1970, Pect's Bridge, 4 miles from Gordonvale (BRI); *Mulgrave Shire Council s.n.*, 23.i.1970, Roadway 3 miles from Gordonvale (BRI); *White 8788*, 3.ii.1933, Botanic Gardens, Brisbane (BRI).

INDIA: ?*Hooker & Thomson s.n.*, 28.v.1850, Garden, Dacca (K — herb Hook. f.); *Anon s.n.*, s. dat. E. India (K—herb. Hook. f.); *Anon s.n.*, s. dat. cultivated — Hort. Bot. Calcutta (K — herb. Hook. f.); *Anon s.n.*, s. dat. Bengal (K — herb. Hook. f.).

4. *Thunbergia laurifolia* Lindl., Gard. Chron. (1856) 260; Hook., Bot. Mag. (1857) t. 4985; Bremek., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. 50 (1955) 47; Backer & Bakh. f., Fl. Java 2 (1965) 552; Herklots, Flow. Trop. Climbers (1976) 24-30.

*Type*: not located, see Typification.

Scrambling vine,? not stoloniferous, glabrous, gland-dotted over stems, leaves and pedicels. *Leaves* with unwinged, 2-5 cm long petioles, blade ovate, 13-19 x 5-9 cm, rounded at base, rarely cordate, 3-5 main veins, glabrous, apex acute. *Inflorescence* a terminal raceme with 4 flowers per node. *Pedicel* 0.8-1.7 cm long. *Bracteoles* fused along one side and part of other, 2.8-3.0 cm long, glabrescent, with cyathiform glands sparsely over entire surface, older ones with fine line of white, intertwined, eglandular hairs confined to margins. *Calyx* an entire ring, persistent in fruit, more or less glabrous, with a ring of nectaries 4-5 deep around top of calyx. *Corolla* blue (from literature); tube 3-4 cm long, constricted at point of insertion of filaments, constricted part striated, but not as markedly as *T. grandiflora*, a ring of very shortly, branched, lax, eglandular hairs on inner surface at apex of constriction. *Stamens* with very broad filaments; one pair of stamens with each anther cell with 3-4 mm long, curved awn at base, the other pair with one anther cell long awned, other with short (0.5 mm long) awn; anthers with long, lax, shortly branched eglandular hairs along length; pollen not spiny. *Disc* hard, surrounding base of ovary. *Ovary* glabrous; stigma cup-shaped, entire. *Capsules* not seen.

### Typification

The type of Lindley's *T. laurifolia* is not housed in CGE, the repository for the major part of Lindley's herbarium. From the original description, Lindley attributes his knowledge of the species to James Veitch & Son the horticulturists, but Hooker (1857) says that Lindley's

original description was based on plants first raised in "Frogmore Gardens from seed presented to Mr Ingram by an officer, who brought or procured it from the Malayan Peninsula — we [Hooker] presume so, at least, from the fact of our having since received and raised seeds of the same plant from Dr Thomson, of the Calcutta Botanic Garden, collected in that region". The specimens of Lindley from Frogmore were "exhibited at the rooms of the Horticultural Society of London in 1856" (Hooker l.c.)

Lindley obviously saw the plant growing as apart from the exhibit he also refers to the "plant before us" as being in far from vigorous health, but whether a specimen was made is unknown, and will have to await enquiries from other herbaria.

Material at K labelled as type of *T. laurifolia* cannot have been the basis for the original description as it was collected 10-20 years after the protologue, but it may represent material from the same source as the type which was perpetuated at Kew Botanic Gardens.

### Distribution

*T. laurifolia* is apparently native to Malaysia and Burma and cultivated elsewhere in the tropics. It is rarely recorded from America, but this may be because of a failure to distinguish between this species and *T. grandiflora*. The only Australian collection is from Kamerunga, near Cairns. Two collections were also seen from New Guinea. Fig. 2.

### Ecology

The species appears to occur on rainforest margins where it completely covers the trees and shrubs, but otherwise little is known about it.

### Notes

1. *Wallace s.n.* (BRI) is the only Australian collection of this species and so it may be a recent introduction. On the other hand it may reflect poor collecting in the Cairns area and an assumption that all big blue flowered species of *Thunbergia* are *T. grandiflora*. It can easily be distinguished from *T. grandiflora* by the glabrous leaves, stems and bracteoles and the large ovate leaves. Bremekamp (1955b) further states that *T. laurifolia* can be distinguished from *T. grandiflora* by the shorter pedicel length in the former and the anther spurs in *T. laurifolia* having small spinules (lacking in *T. grandiflora*). These small spinules were not present in New Guinea material.

2. The Australian specimen lies closest to *T. laurifolia* but differs from it (cf. description Backer 1965) in the possession of a ring of hairs at the constriction of the corolla tube. The hairs are different from those found in *T. grandiflora*, where they are upright, stiff and eglandular; in this case they are lax, shortly branched, eglandular hairs, similar to those found on the anthers. This ring of hairs was also present in New Guinea material of *T. laurifolia*.

### Specimens examined

QUEENSLAND: *Wallace s.n.*, 30.v.1980, Kamerunga, near Cairns (BRI 256476 and 256477).

PAPUA NEW GUINEA: *Millar NGF 38392*, 4.xii.1969, near original McKillop homestead, Kieta subdistrict, Bougainville (LAE).

Specimen intermediate between *T. aff. laurifolia* and *T. grandiflora*

QUEENSLAND: *Kleinschmidt 290*, from the Greenleaves Nursery, Mt Gravatt (BRI).

PAPUA NEW GUINEA: *Benjamin LAE 67836*, 6.iii.1977, near Bus stop, Markham Rd, corner of Angau, Lae (LAE).

## Notes on non-Australian species of *Thunbergia*

### *Typification of T. fragrans Roxb.*

Two specimens were seen from Kew, one each from Bentham's and J.D. Hooker's herbarium.

The specimen in Bentham's herbarium is labelled "Wallich 1831, 2519d" (Wallich specimens with this number were later referred by Nees von Esenbeck (1832, 1847a) to another species *T. angustifolia* Ham. ex Nees.) and bears the annotation "*Thunbergia fragrans*". Wallich spent the years 1828-33 in London cataloguing his own specimens, mainly from British India, but his herbarium also included the collections of a number of earlier botanists including Roxburgh (Anon. 1913). The annotation "Wallich 1831" presumably refers to the year in which Wallich annotated this particular collection, but there is no indication on the sheet that it is a Roxburgh collection.

The collection in the Hooker herbarium bears only the annotation "*Thunbergia fragrans*" in a hand which is possibly Roxburgh's. The size of one of the flowers and some of the bracteoles in this collection is markedly smaller than those in the Bentham collection and those depicted in the illustration accompanying the original description (Roxburgh, 1795). Neither collection could be considered to have been the basis for the illustration in Roxburgh's treatment and they qualify as only possible syntypes of *T. fragrans*. Bremekamp (1955b) made the statement that the Roxburgh collections in K (and those in BM which I have not seen) were from the "Calcutta Botanical Gardens" and do not agree with the plant figured in Roxburgh's 'Plants of the Coast of Coromandel' and can, therefore, not be regarded as types. He considered them to belong to a different, but closely related species. The main discrepancy between the illustration and the specimens is in the shape of the leaves, those of the specimens being deeply cordate and almost hastate, while those depicted in the drawing are very shallowly cordate.

I have not seen material from BM (cited by Bremekamp 1955b) and there may be other material available in Brussels (Merrill, unpubl. list of K). If material upon which the illustration was definitely based cannot be located, it would seem best to consider the illustration itself as the type of the species.

### *Possible syntypes*

*Anon. s.n.*, s. dat. ?India (K — herb Hook.f, Benth.; BM, BR, n.v.).

## 2. NELSONIA R. Br.

The genus *Nelsonia* was first circumscribed in 1810 by Robert Brown. Within it he described two species, *N. campestris* and *N. rotundifolia*, both from tropical Australia. Following the initial publication of the genus there were a number of transfers to it from the genus *Justicia* as well as the publication of new species. These are summarised in Table 7 (p. 55), where the names are listed in order of date of publication of the basionyms.

Roemer & Schultes (1817) were the first to transfer previously recognized *Justicia* species to *Nelsonia* and in their treatment they listed five species world wide (*N. hirsuta*, *N. organoides* and *N. nummulariaefolia* as well as the two Brown species). *N. hirsuta* was based on a combination of two species of *Justicia* from Java, *J. hirsuta* Vahl and *J. brunelloides* Lam.

Sprengel (1825) recognized the same five species as Roemer & Schultes, but added two more. One of these was *N. canescens* from Guinea in Africa and the other *N. lamiiifolia* from

Calcutta in India. Roxburgh (1820) had described the latter in *Justicia* with the comment that Robert Brown had considered that it probably belonged to his new genus *Nelsonia*. *N. albicans* which had been described by Kunth from South America in 1818, was not mentioned in the Sprengel treatment.

Nees (1847b) described a new species, *N. pohlii*, from Brazil and included it in his world treatment of the genus (1847a). He also recognized *N. rotundifolia*, *N. nummulariaefolia*, *N. canescens* and *N. tomentosa*, an Indian species transferred by Dietrich to the genus in 1831. Of Brown's Australian species, *N. campestris* was reduced to a variety of *N. canescens*, and Nees considered that *N. rotundifolia* might only be a glabrous variety of *N. nummulariaefolia*, in turn possibly a variety of *N. canescens*.

Bentham (1868), in his treatment of the genus for the Australian flora, described *Nelsonia* as a single common pantropical weedy species; a similar view had already been advocated by Anderson (1864 & 1867). For this species Bentham chose to use the name *N. campestris* R. Br. This viewpoint was followed in those countries which had a British influence. Thus Clarke (1884) in the British Indian flora, Burkill (1899) in the flora of tropical Africa and Ridley (1923) in the Malay Peninsula flora all used *N. campestris* R. Br.

However, in 1891 the German botanist Otto Kuntze resurrected the epithet 'brunelloides', first published under *Justicia* by Lamarck in 1791 in the same paper as *J. canescens*. Kuntze recognized two varieties under *N. brunelloides*, var. *normalis* and var. *canescens*. Lindau (1895) followed this viewpoint, but without mentioning the varieties. The decision to use 'brunelloides' has been perpetuated in modern American treatments of the genus, e.g. Leonard (1951) for Colombia and Durkee (1978) for Panama.

In a publication by Bremekamp (1944), *Justicia brunelloides* Lam. of Java was shown to belong to the genus *Hemigraphis*. Thus, if *Nelsonia* is viewed as consisting of only a single species world wide, the name having priority must be *N. canescens* (Lam.) Spreng., as used by Bremekamp (1955) in his treatment of Malaysian *Nelsonieae*.

Subsequent to his treatment of Malaysian material, Bremekamp received specimens of *Nelsonia* from New Guinea and Australia and he expressed the opinion (1957, 1964) that these collections were specifically distinct from those he had seen from Malaysia. The characters listed by which the Australian and New Guinean material differed were the much smaller size of the leaves, the nearly complete absence of a petiole, the inconspicuousness of the capitate hairs on the bracts, the sessile flowers, the total absence of capitate hairs on the calyx, the long lateral calyx lobes, the greater length of the corolla tube and the subactinomorphic limb of the corolla.

On this basis he assigned the Australian material to *N. campestris* R. Br., and expressed doubt that all the Asian, African and American specimens could be assigned to *N. canescens* (Lam.) Spreng. There appears to have been no further work in the genus apart from regional flora treatments since that time.

### ***Nelsonia* world-wide**

In determining the correct specific name to be applied to the Australian species (i.e. '*campestris*' or '*canescens*') it is necessary to establish whether the genus comprises one or more species. I have seen some collections from Africa, South America and New Guinea. Though the amount of material is insufficient to carry out a revision it was sufficient, when coupled to modern flora treatments from these areas and Bremekamp's descriptions from Malaysia, to indicate that Australian material is distinct. The degree of distinction, and taxonomic rank applicable, can only be decided by a complete revision of the genus. For this reason it seems best to retain current usage and recognize differences at specific level. Thus, the name *N. campestris* R. Br. has been applied to the Australian taxon.

	Australian	Malaysian	African	South American
<b>leaves</b>				
vegetative	6 x 3.5 cm	12 x 5.5 cm	4 x 1.2 cm	1-8 x 0.5-3.0 cm
floral	8-22 x 4-12 mm	10 x 4 mm	10 x 5 mm	
petiole	0-10 mm	up to 40 mm	?	2-20 mm
pedicel	sessile	0.4-0.8 mm	sessile	sessile
<b>calyx</b>				
lateral lobe length	3.4-4 x 0.6-0.8 mm	3 x 0.7 mm	—	—
<b>corolla</b>				
shape	more or less actinomorphic	2-lipped	2-lipped	? 2-lipped
colour	white	pale blue/purple	blue/purple	deep purple to blue, lobes/tube white
tube	2mm ) or when ) indistinguish- ) able (2.6)	1.5 mm	1.5mm	3.1 mm
throat	1.5mm ) 3.2-4mm long	1.5 mm	1.5 mm	1 mm
lobes	1.5-2.5 mm —	upper 2 mm lower 2.3 mm	1.4 mm —	1.0 mm —
style length	0.8-1.3 mm	1 mm	1.8-1.9 mm	1.9-2.5 mm
filament length	0.3 mm	0.5 mm	c. 0.5 mm	1.2 mm
stamens	included	included	included	slightly exerted
capsule	glabrous	glabrous	with glandular hairs at apex	?with glandular hairs at apex
seed number	28 or more	8-16	12-16	20-22 or (4: Leonard 1951)
<b>Information</b>				
source	specimens	Bremekamp 1955	specimens	one specimen + Leonard 1951 Durkee 1978

Table 6: Comparison of characters of *Nelsonia* taxa from various regions of the world.

In comparing Bremekamp's (1964) list of differences (see above) between the Australian and Malaysian taxa with those characters listed in Table 6, it can be seen that there is a basis for most of his characters. Thus, *Nelsonia* material in Australia has vegetative leaves which do not attain the lengths attributed to them by Bremekamp in Malaysia, the petioles are smaller and the flowers are more or less sessile and actinomorphic compared with pedicellate and 2-lipped in Malaysia. On the other hand, the differences with respect to absence or inconspicuousness of capitate hairs, the longer lateral calyx lobes and the greater length of the corolla tube are not supported by my study of Australian specimens.

Table 6 also shows that Australian specimens differ from material from the rest of the world in corolla colour, often a lack of constriction at the apex of the corolla tube (and thus lack of distinction between tube and throat) and the larger seed number.

From this preliminary survey it appears that the American taxon is distinctive by its longer stamen filaments (and consequently exerted anthers), longer style and seed number. However, it must be emphasized that the sample of American material seen is not sufficient to give an adequate survey. In addition, 'brunelloides' is not the correct epithet to use for the American taxon. If American and African specimens are conspecific the epithet should be 'canescens', if not it should probably be 'nummulariaefolia' (see Table 7).

Basionym	Publication	Locality	Transfer to <i>Nelsonia</i>
<i>J. canescens</i> Lam.	1791	Guinea (Africa)	Sprengel 1825
<i>J. brunelloides</i> Lam.	1791	Java	O. Kuntze 1891
<i>J. hirsuta</i> Vahl	1804	Java	} Roemer & Schultes 1817
<i>J. origanoides</i> Vahl	1804	without locality	
<i>J. nummulariaefolia</i> Vahl.	1804	Puerto Rico	
<i>N. campestris</i> R. Br.	1810	Australia	
<i>N. rotundifolia</i> R. Br.	1810	Australia	
<i>N. albicans</i> Kunth	1818	Colombia	
<i>J. tomentosa</i> Roxb.	1820	India	A. Dietrich 1831
<i>J. lamiifolia</i> Roxb.	1820	Calcutta	Sprengel 1825
<i>N. pohlii</i> Nees	1847	Brazil	

Table 7: History of specific epithets used in *Nelsonia*

*Nelsonia* R. Br., Prodr. (1810) 481; Roem. & Schult., Syst. Veg. (1817) 173; Spreng., Syst. Veg. 1 (1825) 42; Nees in Wallich, Pl. Asiat. Rar. 3 (1832) 75; Nees in A. DC., Prodr. 11 (1847) 65; T. Anders. in J. Linn. Soc. (Bot.) 9 (1867) 450; Benth. in Benth. & Hook. f., Gen. Pl. 2 (1876) 1073; C.B. Clarke in Hook. f., Fl. Brit. India 4 (1884) 394; Lindau in Engl. & Prantl, Nat. Pflanzenfam. IV, 3b (1895) 289; Burkill in Thiselton-Dyer, Fl. Trop. Africa 5 (1899) 28; Ridley, Fl. Malay Penins. 2 (1923) 558; Bremek., Reinwardtia 3 (1955) 246; Bremek., Proc. Kon. Ned. Akad. Wetensch., Ser.C, 67 (1964) 301.

*Type species here designated: N. campestris* R. Br. (see typification)

*Justicia* auctt. non L., p.p.: e.g. Lam., Tab. Encycl. meth. Bot. 1 (1791) 41 p.p. (as to *J. canescens*); Vahl, Enum. 1 (1804) 122 p.p. (as to *J. origanoides* and *J. nummulariaefolia*); Roxb., Fl. India 1 (1820) 135 p.p. (as to *J. tomentosa*).

Pubescent herbs, without cystoliths. *Leaves* petiolate, blade ovate, orbicular or linear lanceolate, entire. *Inflorescence* axillary or terminal, spike of 3-many flowers. *Bract* 1, subtending each flower, more or less spirally arranged, overlapping. *Bracteoles* lacking. *Calyx* 4-partite, segments unequal, free to base, one segment usually 2-toothed at apex. *Corolla* tube with slight constriction at point of insertion of stamens, tube sometimes widening into throat; limb either 2-lipped with 2-lobed upper and 3-lobed lower lip, or 5 more or less equal lobes. *Stamens* 2, inserted in top of tube, included or slightly exserted; filaments with hairs at base; anthers 2-celled, inserted at equal levels, more or less globose, without hairs or appendages but margins overlapping longitudinally when mature, opening at base by a pore which has a small flap; staminodes absent. *Ovary* with 8-28 ovules in 2-4 rows, glabrous; stigma 2-lobed, usually unequally so. *Capsule* conical, seed bearing only at base, 8-28 seeds without hooks at their base. *Seeds* small, globose, not compressed, numerous cristae on outer surface, glabrous. Fig. 3, A-F.

### Distribution

*Nelsonia* is found in Africa, Asia and Australia, where it is endemic. It is also found in tropical America where it may have been introduced. The genus is often treated as one variable weedy species but needs to be revised world wide to confirm this.

*Typification*

There is no type species designated for *Nelsonia* in Index Nominorum Genericorum, although in American literature the type is always cited as *Nelsonia brunelloides* (Lam.) Kuntze from Java. This cannot be correct as Bremekamp (1944 & 1955) has shown *Nelsonia brunelloides* of Java to belong to *Hemigraphis* and as Brown (1810) described two species (*N. campestris* and *N. rotundifolia*) and mentioned 4 other species of *Justicia* which he considered possibly belonged here, but did not include *J. brunelloides*.

The obvious choice for type of the genus must be *N. campestris* R. Br., as of the two species cited by Brown it has the more common usage, with *N. rotundifolia*, if recognized at all, usually being treated as a variety. There is also more material of *N. campestris* known to have been seen and collected by Brown (at least 4 sheets of his own collections in BM, MEL and NSW and probably elsewhere) whereas *N. rotundifolia* was based on possibly a single collection made by Banks & Solander.

Of the four *Justicia* species mentioned by Brown in the protologue, none of these was definitely referred to *Nelsonia* as Brown stated that they perhaps belonged here. It was not until later that they were actually transferred and hence they need not be considered in selection of a type species for the genus.

***Nelsonia campestris*** R. Br., Prodr. (1810) 481; Roem. & Schult., Syst. Veg. 1 (1817) 173; Spreng., Syst. Veg. 1: (1825) 42; Benth., Fl. Austral. 4 (1868) 543, p.p. (excl. extra-Australian distribution); F. Muell., Syst. Census Austral. Pl. (1882) 99; F. Muell., Sec. Syst. Census Austral. Pl. (1889) 167; F.M. Bailey, Qld Fl. 4 (1901) 1142; Bailey, Compr. Cat. Qld Pl. (1913) 368; Ewart & Davies, Fl. North. Terr. (1917) 251; Gardner, Enum. Pl. Austral. Occid. (1931) 119; Bremek., Proc. Kon. Ned. Akad. Wetensch., Ser. C, 67: (1964) 301; Chippendale, Proc. Linn. Soc. N.S. Wales 96 (1971) 259; J. Green, Census Vasc. Pl. W. Austral. (1981) 95.

*Lectotype here designated:* R. Brown s.n., 18.xi.1802, Sweer's (Island a) and Bentinck's (Island b) Islands, Gulf of Carpentaria (BM). *Isolectotypes:* (BM, MEL, K, NSW).

*N. rotundifolia* R. Br., Prodr. (1810) 481; Nees in A. DC., Prodr. 11 (1847) 66. *Possible holotype:* Banks & Solander s.n., 1770, Endeavour River (BM).

*N. canescens* auct. non (Lam.) Spreng.: Nees in A. DC., Prodr. 11 (1847) 67, p.p. (as to Australian material of var.  $\beta$ ); Bremek., Reinwardtia 3 (1955) 248, p.p. (as to Australia).

*N. brunelloides* auct. non (Lam.) Kuntze: Kuntze, Rev. Gen. Pl. 1 (1891) 493, p.p. (as to Australian material); Lindau in Engler & Prantl, Nat. Pflanzenfam. IV, 3b (1895) 289, f. 114, p.p. (as to Australian occurrence); Leonard, Contrib. U.S. Nat. Herb. 31 (1951) 10, p.p. (as to Australian occurrence in Old World Tropics); Durkee, Ann. Missouri Bot. Gard. 65 (1978) 239, p.p. (as to Australian occurrence in Old World Tropics).

Creeping, sprawling, prostrate, or decumbent, hairy, annual (rarely with perennial rootstock?) herb, to 70 cm long and 10 cm high, often rooting at nodes; internode length dependent on habitat. *Leaves* with petioles 2-10 mm long, blade ovate, apically acute, smaller in upper parts and intergrading with bracts, 8-22 x 4-12 mm, usually conspicuously hairy with dense, long, white filiform, eglandular hairs, often mixed with shorter glandular hairs, rarely sparsely covered; larger lower leaves, where present, up to 6 x 3.5 cm with sparse cover of eglandular hairs. *Inflorescence* of dense spikes up to 1-2 cm long, rarely (in some Kimberleys collections) up to 6 cm long. *Bracts* more or less ovate, apically acute, with long filiform hairs mixed with shorter glandular indumentum, 4-6.2 x 2-3.5 mm. *Calyx* usually with dense, long, fine, eglandular hairs at base as long as calyx or exceeding it; posterior lobe 3.0-3.6 x 1.2-1.4 mm, 5-8-veined; lateral lobes 3.1-4.0 x 0.6-0.8 mm, 1-3-veined; anterior lobe usually apically notched, rarely entire or twice notched, 2.6-3.6 x 0.5-1.3 mm, c. 8-veined; all lobes usually more or less glabrous on outer and inner surface except for long eglandular hairs



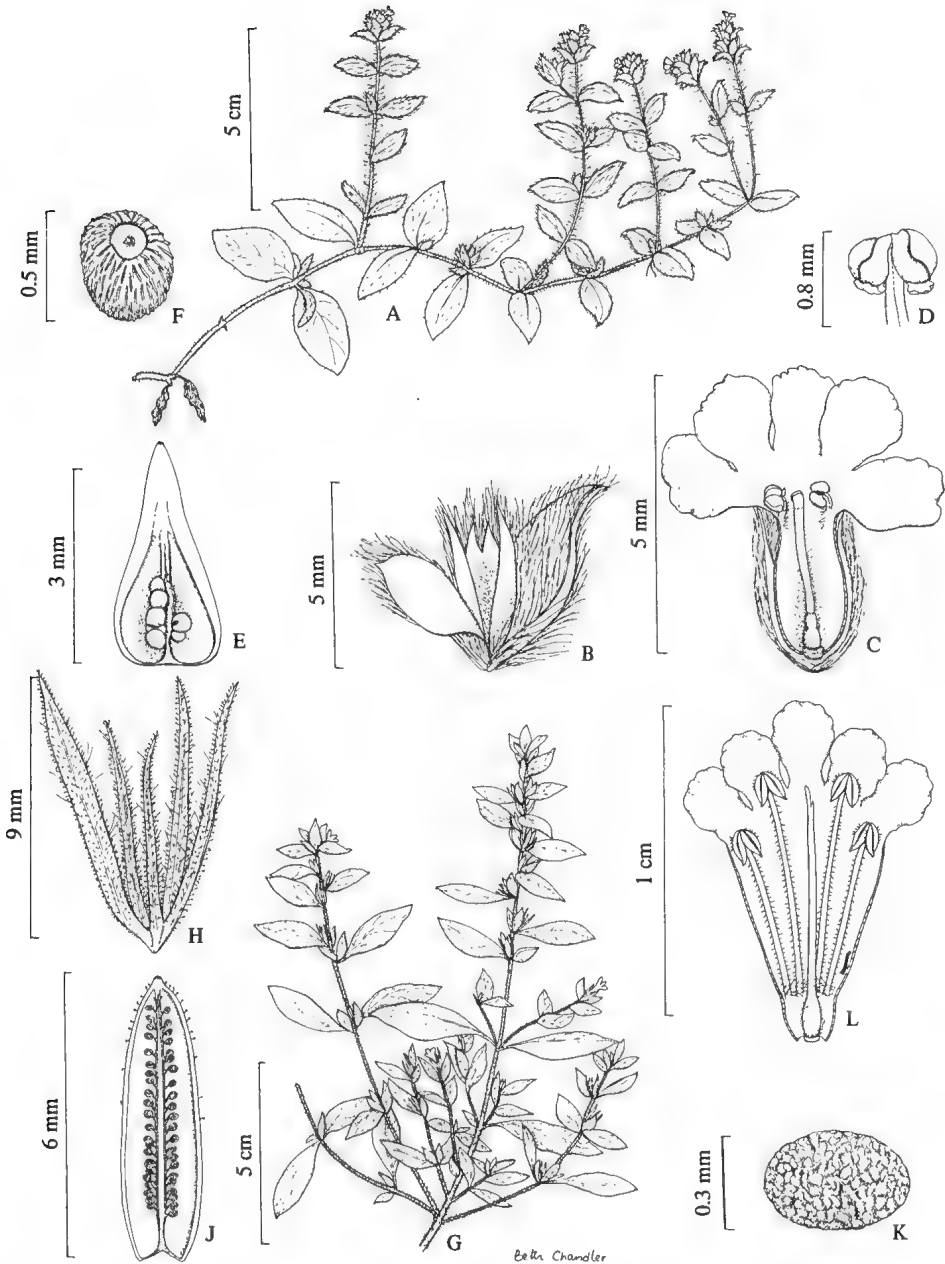


Fig. 3. A-F, *Nelsonia campestris* R. Br. A, habit; B, bract and 4-lobed calyx; C, longitudinal section of flower; D, anthers; E, half capsule with seeds; F, seed (R.M. Barker 320). G-K, *Staurogyne leptocaulis* Bremek. ssp. *decumbens* R.M. Barker. G, habit; H, 5-lobed calyx; I, longitudinal section of flower; J, half capsule with seeds; K, seed (H, J, K, W.R. Barker 2750, G, I, Scarth-Johnson 315A).

mixed with glandular hairs towards apex, rarely these over whole outer surface. *Corolla* white, externally glabrous, or with minute pubescence all over, more or less actinomorphic; tube (2.6) 3.2-4.0 mm long, often with slight constriction at point of insertion of stamens, rarely distinguishable into tube and throat, then the former 2 mm long, the latter 1.5 mm long; upper lobes, if distinguishable, slightly shorter than lower. *Stamens*: filaments 0.3-0.5 mm long, anther cells parallel in bud, divergent in flower, 0.4 mm long, apically with small hook-like mucro. *Ovary* 0.9-1.0 mm long; style c. 0.8 mm long, glabrous. *Capsule* 4-4.8 x 1.5 mm, glabrous, usually c. 28 seeded. Fig. 3 A-F.

### Distribution

*N. campestris* is here treated as if confined to Australia and probably New Guinea, but as already pointed out the specific limitations are in need of revision world wide. Within Australia, *N. campestris* is a common, weedy species found throughout the tropical parts of northern Australia. Fig. 4.

### Ecology

This species is almost invariably found in sandy areas on the banks of rivers, lagoons, waterholes, or in creek or river beds. In Queensland and Northern Territory it is often found associated with *Eucalyptus* and/or *Melaleuca* (often *M. leucadendron*) stands. Flowering specimens are most commonly collected from May-August, although there are a few October collections.

### Notes

1. There are 3 collections from the Gulf of Carpentaria region (Latz 3353, ?Morphett s.n. and Story 8042) which superficially do not agree with the majority of *N. campestris* collections. The anomalous collections consist of dense, compact plants with small (4.5-6 x 3.5 mm) leaves and extremely short internodes. It is assumed that this small size compared to other *Nelsonia* material is a product of habitat — one collection is from sandstone above a coastal cliff, one from gilgai hollows in grassland and one from black soil flats. They would therefore probably be exposed to more extreme weather and water regimes than specimens which come from water-courses or their surrounds. They appear to agree with *N. campestris* in all respects except the size of leaves and internode length, and the fact that in the Story and Latz collections there are glandular hairs on the capsule. This last characteristic allies these 2 collections with African material (see Introduction to the genus, (p. 54).

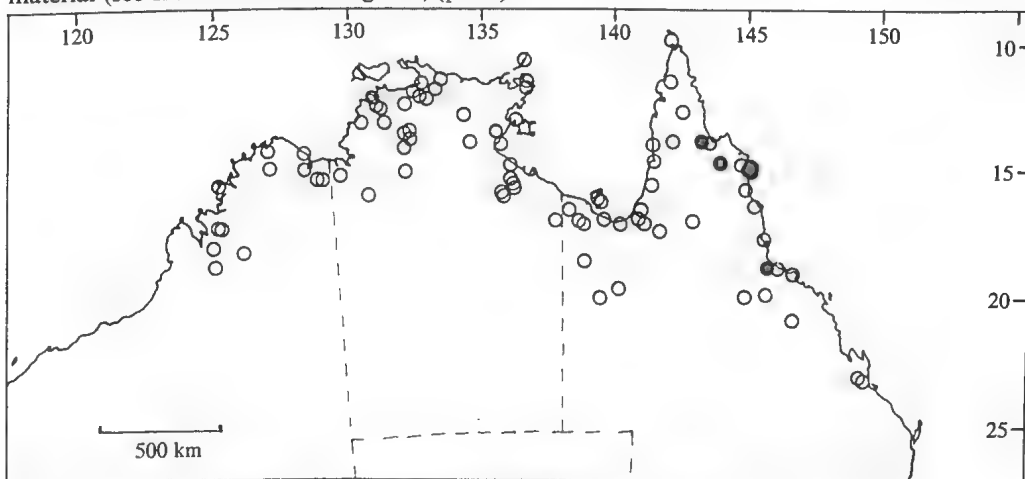


Fig. 4. Distribution of *Nelsonia* in Australia (○ *N. campestris*; ● specimens referable to *N. rotundifolia*).

2. There is a second group of collections from the Cooktown area of Queensland possibly deserving of varietal status and equivalent to R. Brown's *N. rotundifolia*. Their leaves are orbicular and they usually lack the fine filamentous hairs covering the leaves of material of *N. campestris* elsewhere in Australia, possessing instead stout, 3-4-celled, eglandular hairs. Within the corolla tube, in some specimens at least, hairs are not confined to a few at the point where filaments become free of the tube, but extend onto the rest of the upper tube. It appears that most of these specimens come from drier areas; ecological annotations include 'damp sandy ground in *Eucalyptus* forest', 'low savanna', 'granite area' and 'sandstone area/skeletal soil' and this may account for their different appearance. Field observations of populations are needed to determine whether they are worthy of taxonomic recognition. They have been listed separately within the specimens examined and indicated separately on the distribution map (Fig. 4).

3. The collection *George 13188* from Drysdale River National Park, W.A., appears to be unique in possessing sparse eglandular hairs on the margins of the corolla lobes. In addition the style and ovary are very shortly hairy compared with the normal glabrous state in the rest of the material from Australia and the seed number per capsule seems to be about 12 compared with the normal 28 in Australia. This material needs to be compared with other material from Malesia and Africa where the seed number per capsule is recorded as 8-16.

#### *Representative specimens examined* (128 specimens seen)

NORTHERN TERRITORY: *R.M. Barker 352*, 29.iv.1983, Douglas Hot Springs (AD); *R. Brown s.n.*, 18.xi.1802, Sweer's and Bentinck's Islands (BM: lecto-and isoelectotype, MEL 601976, K, NSW); *Chippendale s.n.*, 20.v.1958, Katherine River, near Katherine Hospital (CANB 90952, NSW, NT); *Chippendale s.n.*, 15.vii.1961, Cooper Ck, 28 miles N Oenpelli (BRI 281949, CANB 129863, NSW, NT); *Craven 3953*, 30.v.1976, McArthur River area, sandstone plateau at Bessie Springs (BRI, CANB, NT); *Henshall 313*, 6.vi.1974, Nicholson River area (NT); *Latz 3353*, 1.x.1972, Wessel Islands (BRI, K, NT); *Lazarides 7589*, 10.vii.1974, on Oenpelli Rd, c. 10.5 m from Mudginbarry Homestead (CANB, NT); *Morphett s.n.*, ix.1955, Mt Marumba, Arnhem Land (AD 96146174); *Perry 1706*, 24.vii.1948, 30 miles S of McArthur River Stn (BRI, CANB: 2 sheets, NT); *Specht 615*, 19.vi.1948, South Bay, Bickerton Island (AD, BRI, K, CANB); *Specht 777*, 26.vii.1948, Port Bradshaw (AD, BRI, CANB, K, MEL, NSW); *Specht 953*, 22.viii.1948, Gove (AD, BRI, CANB, MEL, NSW).

QUEENSLAND: *Adams 974*, 21.v.1964, Bolgonunna Ck, 10 m NE of Mt Coolon Township (BRI, CANB, NSW); *Bailey s.n.*, s. dat. Rockhampton (BRI 281938); *Brass 19745*, 30.vii.1948, Archer R, Wenlock-Coen Rd (BRI, K, CANB); *Clarkson 3318*, 13.viii.1980, Magnificent Ck, Kowanyama Aboriginal Comm. (BRI, K, NT); *Clarkson 3496*, 9.x.1980, 60 km W of Strathmay on Musgrave to Edward R Road (NT, K); *Craven 3306*, 19.iv.1975, c. 35 km from Normanton on Georgetown Rd (BRI, CANB); *Michael 607*, s. dat. Mareeba (BRI); *Pedley 1073*, 10.x.1962, Leichhardt R, Mt Isa (BRI); *Perry 1381*, 6.vi.1948, Near Doomadgee Mission (AD, CANB — 2 sheets, MEL, NSW, NT); *Story 8042*, 25.viii.1966, 28 m SW of Galbraith Homestead, 110 m SSW of Mitchell River mouth (CANB).

WESTERN AUSTRALIA: *George 13188*, 3.viii.1975, Dromaius Ck, Drysdale River National Park (PERTH: 2 sheets, CANB); *George 13499*, 7.viii.1975, Drysdale R, near Mogurnda Ck, Drysdale River National Park (PERTH); *Kenneally 1929*, 5.viii.1974, Packsaddle Creek, Ord River Valley, Kununurra (PERTH); *Maconochie 127*, 18.v.1967, 4 m NE of Wyndham Pumping Stn (NT); *Telford 6440*, 4.viii.1977, Bell Ck, N of King Leopold Ranges, at Derby-Gibb River Rd Crossing (CBG).

#### *Specimens referable to N. rotundifolia R. Br.* (see Note 2 and Fig. 4).

QUEENSLAND: *Anon s.n.*, s. dat., Cooktown (MEL 100965); *Banks & Solander s.n.*, 1770, Endeavour River (BM: holotype of *N. rotundifolia* R. Br.); *Blake 2185*, 22.v.1962, Cooktown (BRI); *Byrnes 3345*, 16.v.1975, N of Laura River near Early Man site (BRI); *Jacks s.n.*, 5.v.1976, Upper Keelbottom (BRIU S6699); *Pajmans 2913*, 16.viii.1978, 23 km NE of Violet Vale Homestead Homestead (CANB); *Persietz 33*, 1877, Cooktown (MEL); *Scarth-Johnson 523A*, 3.vii.1977, Cooktown (BRI).

#### **Non-Australian specimens of *Nelsonia* examined**

SOUTH AMERICA: *Nee 9496*, 30.i.1974, Canal Zone, common on open gravel of RR in Gamboa (AD); *Seeman s.n.*, s. dat. Panama (NSW); *Baker 99*, 10.ii.1903, Nicaragua (NSW).

AFRICA: *Thiebaud 706*, viii.1957, Kiala, Katanga Province, Belgian Congo (L); *Codd 7377*, 3.viii.1952, 9 m N of Senanga, Barotseland District, N Rhodesia (L).

WEST IRIAN: *van Royen 4867*, 7.ix.1954, Koerik Camp, N of Koembe River, c 7 km NE of Koembe village, Merauke District (L).

### Excluded species

*Nelsonia brunelloides* (Lam.) Kuntze, Rev. Gen. Pl. 1 (1891) 493 = *Hemigraphis brunelloides* (Lam.) Bremek., Verh. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. 41 (1944) 90.

### 3. STAUROGYNE Wallich

*Staurogyne* was first described by Wallich (1831) in the second volume of his "Plantae Asiaticae Rariores"; it was based on Indian material. Subsequently Nees von Esenbeck (1832) in the third volume of the same work described another genus, *Ebermaiera*, which later proved to be identical with Wallich's *Staurogyne*. Nees (1847a) was aware of this when he wrote his account of the genus in de Candolle's "Prodromus", but chose to use his own name. It was left to Kuntze (1891) to reinstate *Staurogyne* as the correct name for the genus.

The first to recognize the presence of *Staurogyne* in Australia was Mueller (1867), who ascribed material to an Indian species, *Ebermaiera glauca* Nees, a name which has persisted in most Australian literature.

Both Clarke (1884) and Bremekamp (1955) cast doubt on the occurrence of *S. glauca* (Nees) Kuntze in Australia, as the ovary and capsule were reported to be hairy whereas in true *S. glauca* they are glabrous. In a later publication, Bremekamp (1957) pointed out that Australian material of *Staurogyne* came "rather near to '*St. leptocaulis*'" of New Guinea and listed a number of differences, but refrained from describing it as a new species.

As many of his differences are not valid (see Note below) Australian collections are here treated as a new subspecies of *S. leptocaulis* Bremek. It belongs to Bremekamp's subgenus *Tetastichum* (Bremekamp 1955), which Hossain (1972) reduced to a section of *Staurogyne*.

*Staurogyne* Wallich, Pl. Asiat. Rar. 2 (1831) 80, t. 186; Kuntze, Rev. Gen. Pl. 2 (1891) 497.

*Type species: S. argentea* Wallich (India).

*Ebermaiera* Nees in Wallich, Pl. Asiat. Rar. 3 (1832) 75, 79; Nees in A. DC., Prodr. 11 (1847) 70; T. Anders., J. Linn. Soc. (Bot.) 9 (1867) 450; Benth., Fl. Austral. 4 (1868) 544; Benth. in Benth. & Hook. f., Gen. Pl. 2 (1876) 1074; C.B. Clarke in Hook. f., Fl. Brit. India 4 (1884) 395.

Small herbs or undershrubs without cystoliths. *Leaves* opposite, entire, or shortly toothed. *Inflorescence* an axillary or terminal raceme or spike. *Bracts* leaf-like, spirally arranged, becoming smaller higher up. *Bracteoles* 2, below calyx, equal in length to it. *Calyx* with 5 equal or unequal segments. *Corolla* tube gradually widened into throat, limb with 5 more or less equal lobes or (in America) bilabiate, 2 of the lobes enclosing other 3 in bud. *Stamens* 4, didynamous, usually included, staminode sometimes present; filaments pubescent; anther cells 2, inserted at equal level, sometimes very shortly mucronate at base. *Ovary* with 20- many ovules in 2-4 rows in each cell; stigma 2-lobed, sometimes unequally so. *Capsule* ellipsoid, to 60 seeds throughout length, these without hooks at their base. *Seed* small, globose or ellipsoid, not compressed, reticulately ribbed or foveolate, glabrous. Fig. 3 G-K.

#### *Distribution*

About 80 species occur in tropical areas of America, Africa and Asia with the greatest number of species from Sumatra, Borneo and the Malay Peninsula. One species is known in Australia.

### Notes

The Australian material of *Staurogyne* comes closest to *S. leptocaulis* Bremek. of West Irian, but differs in its more robust habit, larger leaves, bracteoles, calyx lobes, flowers and capsules. It seemed that it might also differ from Bremekamp's original description (1957) in possessing an externally glandular hairy corolla and capsule. However, examination of the material cited by Bremekamp reveals that it too has glandular hairs extending onto these parts. The flowers of Australian material tend to be 7-8 mm long and not 10 mm as cited by Bremekamp, the largest calyx lobe 5-7 mm (7 mm by Bremekamp) and capsule 4-5 mm (5 mm by Bremekamp). It therefore seems justifiable to describe the Australian specimens as a new subspecies of *S. leptocaulis*.

The Australian collections may also differ in possessing a staminode in the majority of flowers, but as this staminode was occasionally absent this may not be a reliable character. Staminodes are absent in the type material of ssp. *leptocaulis*, but further New Guinea material will need to be examined to confirm Bremekamp's (1957) contention that they are always absent.

An Australian collection of this taxon at Kew, collected by Mueller, has been annotated by C.B. Clarke as a new species, "belonging to the series *E. glauca* but differing in bracts, stamens, glandular ovary and seeds from the Indian *E. glauca*". This species was never published.

*S. leptocaulis* seems by its glandular hairy capsules, to remain unique in the subgenus *Tetrastichum* to which it was assigned by Bremekamp (1955), but it approaches closely *S. neesii* (Vidal) C.B. Clarke ex Merr. which reputedly has glabrous capsules. Type material of the latter (*Cuming 1083*) seen from K, has no mature capsules to make a comparison.

***Staurogyne leptocaulis* Bremek., Nova Guinea n.s. 8 (1957) 129.**

***Holotype:* van Royen 4678, 13.viii.1954, Netherlands New Guinea. District Merauke, Merau, Merau River, slightly upstream of Koere River, near Kemo (L). *Isotype:* (LAE).**

*Ebermaiera glauca* auct. non Nees: F. Muell., *Fragm. Phyt. Austral.* 6 (1867) 88; T. Anders., *J. Linn. Soc. (Bot.)* 9 (1867) 450; Benth., *Fl. Austral.* 4 (1868) 544; C.B. Clarke in Hook. f., *Fl. Brit. India* 4 (1884) 396; F. Muell., *Syst. Census Austral. Pl.* (1882) 99; F. Muell., *Sec. Syst. Census Austral. Pl.* (1889) 167 as "Ebermayera"; F.M. Bailey, *Qld Fl.* 4 (1901) 1143; F.M. Bailey, *Compr. Cat. Qld Pl.* (1913) 368; Ewart & Davies, *Fl. North. Terr.* (1917) 251; Gardner, *Enum. Pl. Austral. Occid.* (1931) 119; J. Green, *Census Vasc. Pl. W. Austral.* (1981) 95.

*Staurogyne glauca* auct. non (Nees) Kuntze: Bremek., *Reinwardtia* 3 (1955) 168 (as to Australian plants); Bremek., *Nova Guinea n.s.* 8 (1957) 129 (as to Australian plants).

Initially small, erect, viscid herbs to 25 cm high, becoming decumbent and more branched with age, often rooting at nodes. *Branches* terete, glandular hairy when young, often purple. *Leaves* more or less sessile, or with petiole to 9 mm long; blade oblanceolate to ovate, base long tapering, entire or shortly toothed in upper half, usually obtuse, more rarely acute, grading into bracts, glandular hairy on both surfaces when young, glabrescent with age. *Inflorescence* terminal or axillary leafy spike, each flower subtended by leaf-like bract near base of spike, these becoming smaller and spirally arranged higher up, glandular hairy on both surfaces. *Bracteoles* leaf-like, ovate, usually slightly shorter than calyx, similar indumentum to leaves and bracts. *Calyx* lobes free almost to base, glandular hairs all over, sometimes mixed with longer eglandular hairs, particularly on margin, unequal, one larger and 3-nerved, other 4 more or less equal, acute. *Corolla* blue, whitish-lilac, pale lilac or mauve, 3 of lobes at least sometimes with darker (?red) lines, external surface with fine glandular hairs particularly on throat and lobes; tube constricted at point of insertion of stamens just above ovary, internally with ring of hairs at constriction. *Stamens* with one pair just exerted, 4-5.5 mm long, other pair included, 3-4.5 mm long, sometimes (particularly in Australian material) with small staminode present; anther cells very shortly mucronate, divergent at base, sparsely hairy apically on backs of cell;

connective saggitate, hairy on back. *Ovary* ellipsoid, glabrous; style glabrous, c. 5 mm long; stigma bilobed, upper lobe smaller and forked, lower entire or forked. *Capsule* ellipsoid, apically acute or obtuse, glandular hairy on outer surface, seeds in 4 rows (i.e. 2 per cell), 14-25 in each row.

*Distribution*: see under infraspecific taxa.

### Key to infraspecific taxa of *S. leptocaulis*

- 1a. Branches erect or decumbent. Largest leaves 2.9-4.5 x 1-2 cm, with 5-8 pairs of main lateral veins. Bracteoles 7-8 x 2-4 mm. Largest calyx lobe (7.5) 8.5-10.5 mm long. Corolla 10-13 mm long. Capsule (4.5) 5.5-6.6 mm long. Staminode usually present. (Australia) ..... b. ssp. *decumbens*
- 1b. Branches trailing, weak. Largest leaves 1.2-3.5 x 0.3-0.65 cm, with 3-5 pairs of main lateral veins. Bracteoles 5-6 x 1.5 mm. Largest calyx lobe 5-7 mm long. Corolla 7-10 mm long. Capsule 4-5 mm long. Staminode ? always absent. (New Guinea) ..... a. ssp. *leptocaulis*

#### a. ssp. *leptocaulis*

Trailing herb with weak branches, basal parts becoming slightly woody with age. Lower leaves largest, 1.2-3.5 x 0.3-0.65 cm, 3-5 pairs of main lateral veins, becoming smaller higher up. Bracteoles elliptic, 5-6 x 1.5 mm. Calyx: larger lobe 5-7 x 1.2 mm, smaller lobes 6-6.5 x 0.2-0.3 mm. Corolla length 7-10 mm, lobes c. 1.5 mm long. Stamens: staminode ? always absent. Capsule 4-5 mm long.

#### *Distribution*

Ssp. *leptocaulis* is known by only three collections from the Merau and Morehead Rivers in Western and Merauke regions of south-central New Guinea.

#### *Ecology*

Recorded from an "open spot in Eucalyptus-Melaleuca forest" on a river bank (*van Royen* 4678) and from a grass plain amongst very low grasses (*van Royen* 4855).

#### Notes

1. There may be more collections of this subspecies than I have seen, because the purpose of this work was clarification of the Australian taxa, and only types and the holdings of the LAE herbarium have been inspected. The genus is prone to misidentification because it lacks the distinctive characteristics of most Acanthaceae and is sometimes placed in Scrophulariaceae.

2. Leonard (1958) described a new species of *Staurogyne* from Colombia and also used the epithet '*leptocaulis*'. Since Bremekamp's description of *S. leptocaulis* from Irian Jaya was published in 1957, it has priority over that of Leonard.

#### *Specimens examined*

NEW GUINEA: IRIAN JAYA: *van Royen* 4678, 13.viii.1954, District Merauke, Merau, Merau River, slightly upstream from Koere River, near Kemo (L: holotype, LAE); *van Royen* 4855, 7.ix.1954, Merauke District, Koerik Camp, N of Koembe R, c. 7 km NE of Koembe village (L). PAPUA NEW GUINEA: *Pullen* 7060, 14.viii.1967, Morehead River, c. 8 miles inland at Long. 141° 30', Western District (LAE; CANB, L, A, K, BRI, n.v.).

#### b. ssp. *decumbens* R.M. Barker, ssp. nov.

*Ebermaiera glauca* auct. non Nees: see under species.

*Staurogyne glauca* auctt. non (Nees) Kuntze: see under species.

Subspecies nova *S. leptocaulis*, a ssp. *leptocauli* differt habitu erectove decumbenti, foliis magnis (2.9-4.5 x 1-2 cm) a 5-8 nervis principalis, bracteolis magnis (7-8 x 2-4 mm), lobis calycis magnis (lobo magniore (7.5) 8.5-10.5 x 1-1.5 mm, lobis parvioribus (7) 8-9.5 x 0.4 mm), corollis magnis (10-13 mm longis) et plerumque staminodio, capsulis magnis (4.5) 5.5-6.6 mm longis.

*Holotype*: George 14054, 19.viii.1975. Palmoondoorra Ck, above Morgan Falls, Drysdale River National Park (CANB). *Isotype*: PERTH.

Erect or decumbent herb, with branches often becoming woody with age. *Lower leaves* largest, 2.9-4.5 x 1-2 cm, 5-8 main lateral vein pairs, becoming smaller higher up, grading into bracts. *Bracteoles* more or less ovate, 7-8 x 2-4 mm. *Calyx*: larger lobe (7.5) 8.5-10.5 x 1-1.5 mm, smaller lobes (7) 8-9.5 x 0.4 mm. *Corolla* 10-13 mm long, lobes c. 2 mm long. *Stamens*: staminode usually present, rarely lacking. *Capsule* (4.5) 5.5-6.6 mm long. Fig. 3 G-K.

### Distribution

*Ssp. decumbens* is found in the northern-most areas of Australia from Cape York Peninsula, Arnhem Land and the Kimberleys. Fig. 5.

### Ecology

The subspecies has been recorded by rivers or creeks, occurring as a semi-aquatic on the margins or banks, on flood plains, or in damp mud near falls. It has been found associated with *Melaleuca* spp., within bloodwood-stringybark (*Eucalyptus*) woodland and also in "deciduous vine thicket". Flowering specimens have most commonly been collected from May to August.

### Specimens examined

NORTHERN TERRITORY: *Adams* 2803, 11.vii.1972, Nourlangie Creek crossing on Jim Jim-Oenpelli Rd (CANB); *Anon* 124, vii.1833, Pine Creek (MEL 100747); *Baldwin Spencer s.n.*, vii-viii.1911, Edith Creek (MEL 100750, NSW 148557); *Baldwin Spencer s.n.*, vii-viii.1911, Abraham Lagoon (MEL 100749, NSW 148591); *W.R. Barker* 2750, 9.viii.1978, Batten Ck, c. 11 km by road SW of Ryan Bend Yard; c. 34 km WSW of Borroloola (AD); *Blake* 16170, 27.vii.1946, Near Hayes Ck Farm (BRI); *Byrnes* 1253, 19.xii.1969, Elizabeth River (CANB, DNA); *Byrnes* 2183 & *Green*, 22.vi.1971, Nourlangie Creek (CANB, DNA); *Craven* 4657, 7.vii.1977, Banks of Nourlangie Creek (CANB); *Craven* 6119, 29.v.1980, near Deaf Adder Creek, 24 km NNE of Jim Jim Falls, Kakadu National Park (CANB); *Hartley* 13756, 28.v.1973, Tin Camp Creek, about 20 miles S of Nabarlek mining camp (CANB); *Latz* 7668, 9.vi.1978, Jabiru area (AD); *Lazarides* 8796, 17.v.1980, near Jim Jim Creek, 6 miles SE of Cooida (CANB); *Mueller s.n.*, x.1855, near Provision Hill, rivulet of McAdams Range (MEL 100752); *Mueller s.n.*, x.1855, Provision Hill and rivulets towards the Fitzmaurice (K); *McKean* 1146, 1.i.1973, 5 m NW Adelaide River Township (DNA); *Parker* 127, 4.vii.1973, Tortilla Flats (DNA); *Perry* 2621, 27.vii.1949, near Alligator Springs, 70 miles E of Carlton Stn (BRI, CANB (2 sheets) NT.); *Rice* 2956A, 6.vi.1978, Koongarra-Hickey Creek (CANB); *Rice* 3029, 6.ix.1978, Cooper Creek, 1st large billabong N of Nabarlek (CANB); *Robinson* R381, 8.v.1964, 1½ miles SW Old Litchfield Homestead (DNA); *Schultz* 446, s. dat, Port Darwin (MEL); *Symon* 7918, 27.vi.1972, Liverpool River Crossing, near 12° 27', 134° 06' (ADW, NT); *van Balgooy & Byrnes* 1338, 24.vii.1971, Mudginbarry, Magela Creek (CANB); *White* MR31, vi.1955, Mary River Camp (CANB).

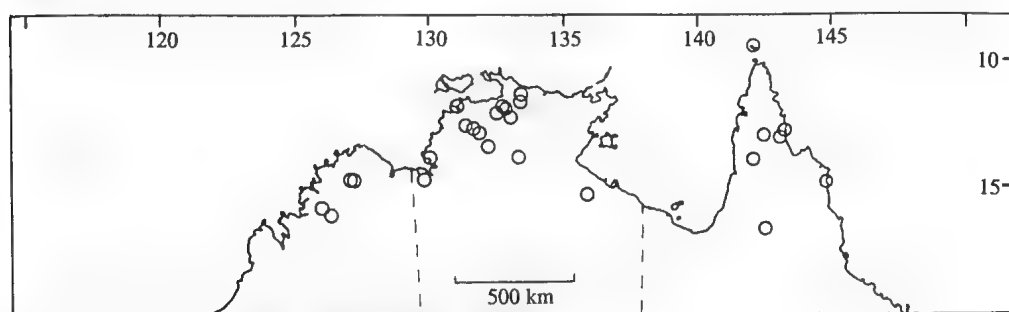


Fig. 5. Distribution of *Staurogyne leptocaulis* ssp. *decumbens*.



QUEENSLAND: *Armit 615*, s. dat., Etheridge & Einasleigh (Rivers) (MEL 100748); *Brass 19782*, 3.viii.1948, Coen River (CANB); *Clarkson 3559*, 14.x.1980, 15.2 km E of the old Strathgordon homestead on the road from Edward River to Musgrave (BRI); *Garnett 200*, 19.ix.1979, Badu Island, Torres Strait (BRI); *Johnson s.n.*, 1891, Stuart's River (MEL 100746); *Pajmans 2931*, 18.viii.1978, 10 km NW of Silver Plains homestead (CANB); *Scarth-Johnson 315A*, July, Oakey Creek (BRI); *Wrigley & Telford NQ 1572*, 22.vi.1972, 28 km from Musgrave Homestead towards Marina Plains (CBG).

WESTERN AUSTRALIA: *Fitzgerald 1039*, vi.1905, Isdell River, 4 miles below Mt Barnett homestead (PERTH); *Fitzgerald 1400*, viii.1905, Charnley River near F.B.33 (PERTH); *George 14054*, 19.viii.1975, Palmoondoor Ck, above Morgan Falls, Drysdale River National Park (CANB: holotype, PERTH); *Kenneally 4335*, 15.viii.1975, Euro Gorge, Drysdale River National Park (PERTH).

### Notes on non-Australian species of *Staurogyne*

#### 1. *Staurogyne neesii* (see p. 61).

##### *Specimen examined*

PHILIPPINES: *Cuming 1083*, 1841, Prov. Albay, Luzon (K).

#### 2. The status of *Staurogyne glauca* (Nees) Kuntze

Annotations on the type specimens of *S. glauca* (Nees) Kuntze indicate that this name may disappear into synonymy as it is predated by *S. spatulata* (Bl.) Koord. Bremekamp (1955) maintained the two species as distinct, including both under his subgenus *Tetrastichum*, both reputedly having anthers without mucros ("non-appendiculate"), and differing according to Bremekamp in "the number of flowers that are subtended by leaves instead of bracts . . . by the acute instead of obtuse bracteoles, and by the narrower and acute posticous calyx lobe".

Clarke (1884) referred to *S. spatulata* as a variety of *S. glauca* (nomenclaturally incorrect as 'spatulata' is the prior epithet) saying that the anther cells of *S. glauca* were "muticous or minutely mucronate at base". In type material of *S. glauca* (Nees) Kuntze which I have seen from Kew, some of the anthers are definitely mucronate at the base. It would be necessary to see type material of *S. spatulata* (Bl.) Koord. to determine whether Bremekamp is correct in describing the anther cells of this taxon as "non-appendiculate".

Annotations made in 1971 on material in Kew indicate that Enayet Hossain regards the two taxa as conspecific, *S. spatulata*, with a var. *glauca*, but I have been unable to find a published reference to this.

Of the 4 sheets in K, all from Wight's herbarium, 3 have the annotation '*Stemodia glauca*' as described by Nees, but possibly only one of these has been seen and annotated by Nees and this could probably be designated the holotype of the species.

##### *Specimens examined*

INDIA: *Wight s.n.*, s. dat., ?India (K: 2 sheets, 1 the possible holotype); *Wight 9083*, xii.1817, Madras & Travancore (K: herb. Benth. & herb. Hooker).

### 4. ACANTHUS L.

Robert Brown (1810) listed two species of *Acanthus* from Australia, *A. ilicifolius* and *A. ebracteatus*. However, Bentham (1868) cast doubt on the differences between the species, mainly because of inadequate material:

"*A. ebracteatus* . . . is distinguished by almost all botanists as a species by the absence of bracts, and usually by the want of the stipular spines at the base of the leaves. Both the bracts and these spines are so variable in size, that in the usually indifferent specimens in the collections before me, I am quite unable to ascertain whether there really are or not two distinct forms, all the other characters being precisely the same in both. . . . Brown's specimens of *A. ebracteatus* have the subtending bract, but the bracteoles very minute or deficient and the stipular spines wanting".

This statement seems to have been sufficient for subsequent workers in Australia to ignore *A. ebracteatus* until it was reinstated by Domin (1929) for Queensland and it appeared in Green's (1981) Western Australian census. In a treatment of the mangrove vegetation of Papua New Guinea, Percival & Womersley (1975) were unable to decide whether there was one or two species involved, and so treated all material as *A. ilicifolius*.

Many of the problems associated with *A. ebracteatus* probably arise because the species in fact possesses bracts but lacks prominent bracteoles, although these are sometimes present in a diminished state. Further difficulties are caused in Australia because the flower size difference between the two species in Malesia does not occur here (see Note under genus).

*Acanthus* L., Sp. Pl. 1 (1753) 639; R. Br., Prodr. (1810) 480; Benth., Fl. Austral. 4 (1868) 548; Benth. & Hook. f., Gen. Pl. 2 (1876) 1090; Lindau in Engler & Prantl, Nat. Pflanzenfam. IV, 3b (1897) 318; Bremek., Proc. Ned. Akad. Wetensch., 58 (1955) 298.

*Type species: A. mollis* L.

*Dilivaria* Juss., Gen. Pl. (1789) 103; Nees in Wallich, Pl. Asiat. Rar. 3 (1832) 98; Nees in A. DC., Prodr. 11 (1847) 268: Not used with respect to Australian occurrences.

Erect or decumbent shrubs, or undershrubs, or (introduced species) with leaves in basal rosette, without cystoliths, sometimes spiny; branches not constricted above nodes, more or less cylindrical, sometimes grooved longitudinally. *Leaves* petiolate, entire, lobed or irregularly dentate, sometimes with spines, herbaceous or leathery, sometimes gland-dotted, glabrous, opposite pairs not connected by transverse ridges. *Inflorescence* a terminal spike arising from upper parts of plant, or (introduced *Acanthus*) at apex of scape arising from rosette of leaves. *Bract* 1, subtending 2 bracteoles and a single large flower, or bracteoles lacking. *Calyx* 4-partite, 2 larger (abaxial and adaxial) segments outermost, inner two (lateral) smaller, in introduced *Acanthus* adaxial calyx lobe functions as upper lip of corolla. *Corolla* with short tube, and large, shortly 3-lobed, lower lip; upper lip lacking. *Stamens* 4, inserted at top of corolla tube in more or less equal pairs, exerted, with extremely thick filaments, those of abaxial pair twisted slightly such that their anthers are pressed against corresponding anther of adaxial stamen; anthers 1-celled, pressed against each other, usually bearded along sutures, dorsal surface usually with a line of villous hairs to one side of mid line. *Ovary* glabrous, 2 superposed ovules per cell; stigma usually 2-lobed, sometimes obscurely so. *Capsule* ovoid-oblong, shining, glabrous, leathery, with 2 or 4 seeds borne upon strong hooks. *Seeds* large, more or less discoid, glabrous, tuberculate, or (in *A. cf. mollis*) surface smooth. Fig. 1 A-J.

### *Distribution*

*Acanthus* is a small genus of perhaps 8-10 species with the 3-4 mangrove species of subgenus *Dilivaria* occurring from India, Polynesia and Australia. The rest of the species occur in forests in Europe and Africa. In Australia the two native species are both found within mangrove vegetation of northern Australia. A third introduced species is commonly cultivated in Australian gardens, with some records of its escaping. This species is usually referred to *A. mollis*.

### *Notes*

1. There is some controversy about the merits of *A. ebracteatus* as a species. Since the two species, *A. ilicifolius* and *A. ebracteatus*, have similar vegetative characteristics and the differences between them rely on the presence or absence of bracteoles which are often lost at anthesis, many people have been wary when making identifications. Within Malesia, flowers of *A. ilicifolius* are apparently quite markedly larger than those of *A. ebracteatus* (see Bremekamp

Characters	<i>A. liticifolius</i>				<i>A. ebracteatus</i>			
	Malesia (Bremekamp 1955)	Java (Backer 1963)	Australia (based on specimens)	New Guinea (based on specimens)	Malesia (Bremekamp 1955)	Java (Backer 1963)	Australia (based on specimens)	New Guinea (based on specimens)
axillary thorns	present	present	usually present	usually present	present or not	present or not	absent	present or not
bracteoles	present	present	present	present	usually absent	usually absent	usually absent	usually absent
bract size	7-9 mm	7-9 mm	6.5-8 mm	6.5-8.2 mm	3-6 mm	3-4 mm	6.5-8.2 mm	6.5-8 mm
bracteole size	more or less equal to bracts	6-8 mm	6-8 mm	5.5-6.5 mm	—	3-4 mm	only 1 seen: 4 mm	only 1 seen: 3.3 mm
bract/bracteole apex	spinose- mucronate	—	often spine- tipped	acute to obtuse	—	—	obtuse	obtuse
corolla length	3.5-4 cm	3-4.5 cm	2.2-3 cm	2.8 cm	1.5-3 cm	2-3 cm	2.2-2.6 cm	2.2-2.4 cm
tube length	—	7.5-10 mm	4.5-7.2 mm	c. 6 mm	—	5-8 mm	5.7-6 mm	6-8 mm
filament length	15-20 mm	13-16 mm	11.13-mm	c. 13 mm	7-12 mm	7.5-12.5 mm	10-11 mm	10-11 mm
anther length	8-8.5 mm	—	6.3-6.5 mm	6.2 mm	4-6 mm	—	6 mm	5-6.5 mm
style length	25 mm	22.5-25 mm	17-18 mm	15-18 mm	10.15 mm	20 mm	12 mm	12-18 mm
calyx length	13 mm	12-15 mm	11-12 mm	11-13 mm	7-11 mm	7.5-12.5 mm	10-10.5 mm	10-10.5 mm
sessile glands on dorsal surface of abaxial pair of stamens	?	?	present	present	?	?	absent	mostly absent
suture of anther of abaxial pair of stamens	densely ciliate	?	ciliate along one or both sides	ciliate along one or both sides	densely ciliate	?	glabrous along both sides	ciliate along one side
corolla colour	dark blue or violet, rarely white	violet with yellow median band, rarely white	blue, mauve, whitish edged with lilac	bright blue to violet — ? becoming white. Internally with a yellow spot.	white or pale blue	white	blue-purple, dark blue, purple/lilac	white with blue margins: scented or not.

Table 8: Comparison of characteristics for *A. liticifolius* and *A. ebracteatus* from Malesia, Australia and New Guinea.

& Backer measurements in Table 8) and this gives rise to a number of differences. However, in Australia this flower size difference does not occur, and until recently collections of *Acanthus* have been mostly referred to *A. ilicifolius*. A small group of specimens which, apart from the single WA collection *Smith & Johnson* PERTH, had been referred to *A. ilicifolius*, have proved to be ebracteolate and these have here been placed under *A. ebracteatus* as a distinct subspecies. This is due to comparison with New Guinea material of *A. ebracteatus* which revealed differences in distribution of hairs on the anthers (see further comments under *A. ebracteatus* and Table 8).

Within Australia at least, the character of presence or absence of bracteoles always works. In *A. ilicifolius* the bracts and bracteoles are usually not lost after anthesis and often persist even after the fruit has been dispersed. In the new subspecies, however, the single bract may or may not be present after anthesis, and the small bracteoles are usually completely absent.

While it is apparently impossible to distinguish *A. ilicifolius* and *A. ebracteatus* vegetatively (Bremekamp 1955), it may be possible to distinguish *A. ilicifolius* and the newly described Australian *A. ebracteatus* ssp. *ebarbatus* (see below) by the presence or absence of axillary thorns. At this stage ssp. *ebarbatus* collections all lack axillary thorns while *A. ilicifolius* collections only very rarely lack them. Further collections of ssp. *ebarbatus* should clarify whether this is a valid difference.

2. Some initial observations have been made on the pollination strategies of *A. ilicifolius* by Primack et al. (1981). They observed that the flowers of Queensland plants were adapted for cross-pollination rather than self-pollination, although the latter can occur. The stigma apparently only becomes receptive after the flower has been open for a full day while pollen is present for the whole time. The pollinator, in probing for nectar at the base of the flower, separates the two pairs of stamens, allowing the stigma to descend and pick up pollen from its back. When the pollinator withdraws from the flower the anthers come together again and pollen is deposited on its back. The only pollinator they observed was the yellow-breasted sunbird, although they suspected that *Xylocopa* bees might also be involved.

The presence of large, sessile glands on the dorsal surface of the abaxial stamens of *A. ilicifolius* (personal observation) may also be important in attracting pollinators; the products of these glands would be available to visitors approaching from above the stamens. In addition, the function of the hairs along the sutures may be of some importance in regulating pollen flow. The lack of these sessile glands in *A. ebracteatus* ssp. *ebarbatus* and the fact that the abaxial pair of stamens lack any hairs along the suture, may point to a different pollinator or possibly a different pollination mechanism, although in other respects (except perhaps flower colour and scent) the flowers of *A. ilicifolius* and *A. ebracteatus* appear to be identical in Australia.

### Key to *Acanthus* species native and naturalised in Australia

- 1a. Bracts pubescent, large (at least 3 cm long), with 4-5 (-7) spiny teeth on each side of midrib. Corolla c. 4-4.5 cm long, with outer two calyx lobes unequal in size, the upper (adaxial) appearing to play the function of upper lip of corolla and c. 4 cm long, the lower c. 3 cm long. Leaves large, up to 50 x 30 cm, herbaceous, without glands. Style apex distinctly 2-partite. Bracteoles linear-lanceolate, c. 20 mm long, pubescent, always present. Ovary at least at apex and base of style pubescent. Seed coat smooth. Garden escape ..... 3. *A. cf. mollis* L.
- 1b. Bracts glabrous, less than 1 cm long, with entire or ciliate margins. Corolla 1.5-3 cm long, with outer two calyx lobes 7-15 mm long, much shorter than corolla and not playing function of upper lip. Leaves 18 x 5 cm, leathery, gland-dotted. Style apex more or less entire. Bracteoles ovate or oblong, 3-8 mm long, glabrous, or lacking. Ovary and style glabrous. Seed coat closely rugose. Native components of mangrove vegetation in northern Australia ..... 2

- 2a. Flowers subtended by one bract and (1)-2 bracteoles of similar length to bract (6-8 mm long). Branches (in Australia) with 2-4 axillary thorns per node. Lower bracts and bracteoles (and rarely calyx segments) often with spiny apex, densely pubescent internally. Abaxial pair of stamens with sessile glands on dorsal surface of anthers, extending to the top of the filament ..... 1. *A. ilicifolius*
- 2b. Flowers subtended by one bract only, very rarely with two smaller (4 mm long) bracteoles. Branches (in Australia) without axillary thorns. Bracts, bracteoles and calyx segments with obtuse apex, glabrous, or sparingly pubescent internally. Abaxial pair of stamens without sessile glands on dorsal surface of anthers at least in Australia ..... 2. *A. ebracteatus*

1. *Acanthus ilicifolius* L., Sp. Pl. (1753) 639; R. Br., Prodr. (1810) 480; T. Anderson, J. Linn. Soc., Bot. 9 (1867) 501; Benth., Fl. Austral. 4 (1868) 548; F. Muell., Syst. Census Austral. Pl. (1882) 99; F.M. Bailey, Syn. Qld Fl. (1883) 368; Clarke in Hook. f., Fl. Brit. India 4 (1885) 481; F. Muell., Sec. Syst. Census Austral. Pl. (1889) 167; F.M. Bailey, Catal. Pl. Qld (1890) 34; F.M. Bailey, Qld Fl. 4 (1901) 1146; F.M. Bailey, Compr. Cat. Qld Pl. (1913) 374; Ewart & Davies, Fl. N. Terr. (1917) 252; Domin, Biblioth. Bot. 89 (1929) 603 (including var. *subinteger* Nees); Bremek., Proc. Ned. Akad. Wetensch., Ser. C, 58 (1955) 298; Chippendale, Proc. Linn. Soc. N.S. Wales 96 (1971) 259; Lear & Turner, Mangroves of Austral. (1977) 28, 78; K.A. Williams, Native Pl. Qld (1979) 8: with plate; Primack et al., *Austrobaileya* 1 (1981) 346.

*Type: Anon. s.n., s. dat. India (Herb. LINN 816.6)*

*Dilivaria ilicifolia* (L.) Juss., Gen. Pl. (1789) 103; Nees in Wallich, Pl. Asiat. Rar. 3 (1832) 98; Nees in A. DC., Prodr. 11 (1847) 268. Not used with respect to Australian taxa.

Spreading, erect, multistemmed bush, 1-1.5 m high; branches with (2) -4 axillary thorns at each node. *Leaves* with petioles 2-13 mm long, rarely sessile, blade ovate, to 7.6-18.5 x 2.6-5.3 cm, entire or dentate, leathery, glabrous, gland-dotted, apex and teeth, when present, spine-tipped. *Inflorescence* a dense spike 6.0-9.5 cm long, often with several distinct transverse ridges (cicatrices) across rachis in internodes. *Bracts* sessile, more or less lanceolate, 6.5-8.0 cm long, leathery, with entire membranous and ciliate margins, rarely with few small teeth along margin (see Note 1), often spine-tipped at apex at least in lower parts of spike, velvety pubescent inside and sometimes externally towards bract apex. *Bracteoles* narrower than bracts, 6.0-8.0 mm long, entire, ciliate, apically usually spine-tipped, shortly pubescent on outer surface about apex and on inner surface. *Calyx* segments with obtuse, acute, notched or rarely (Note 1) spine-tipped apex, ciliate, externally shortly pubescent near apex, larger segments 11-12 mm long, smaller c. 8.2 mm long. *Corolla* 2.2-3.0 cm long, blue, mauve, whitish with lower lip edged lilac, or blue with white throat, scent unknown; tube 4.5-7.2 mm long, thickened and with ring of hairs at top about point of insertion of stamens; lobes appressed hairy on inner surface, glabrous on outer surface. *Stamens* with filaments more or less equal length, 11-13 mm long, cream, abaxial pair somewhat wider than adaxial; anthers purple or maroon, those of abaxial stamens on dorsal surface with line of villous white hairs (c. 2.5 mm long) and sessile glands which extend on to apex of filament, along one side of suture with short (1.4 mm long), stiff hairs, adaxial stamens with line of villous hairs along dorsal surface to one side of mid line, without sessile glands and with stiff, white 1.3-1.4 mm long hairs along both sides of suture. *Ovary* with style 17-18 mm long, scarcely notched at apex. *Capsule* 1.7-2.5 cm long. *Seed* 6-9 x 5.2-6 mm, yellow, closely rugose. Fig 1 A-D.

### *Distribution*

*A. ilicifolius* is a mangrove species found from India, throughout Malesia and extending to the Solomon Islands, New Hebrides and New Caledonia. It has apparently been introduced to South Africa (Clarke 1901). In Australia it is found along the tropical coastlines of Queensland and the Northern Territory. Fig. 6.

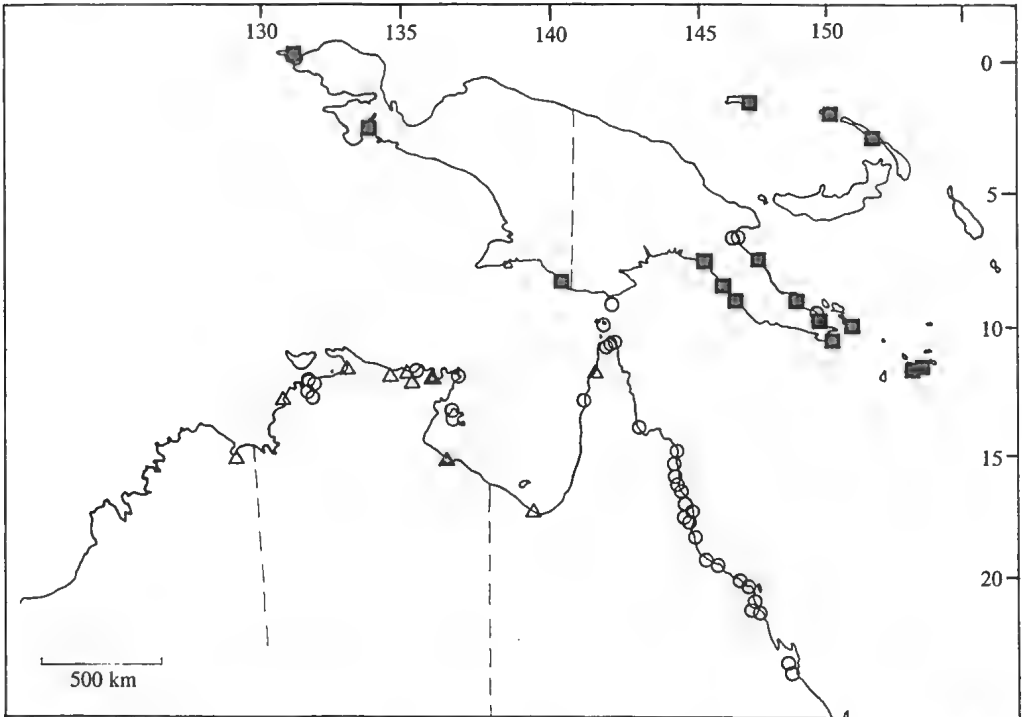


Fig. 6. Distribution of *Acanthus* species in Australia and New Guinea (○ *A. ilicifolius*; ■ *A. ebracteatus*; △ ssp. *ebarbatus*; ▲ ? ssp. *ebarbatus*).

### Ecology

*A. ilicifolius* is always found at sea level, usually on river banks in saline tidal areas associated with mangroves and flowering from August to December.

### Notes

1. The specimens *Dietrich* 634, 2159, *Blake* 16793 and *Macnae* 12.6 agree with *A. ilicifolius* except that in all cases they have small, spiny teeth on the basal bracts and, in the case of the *Macnae* specimen, the basal bracteoles, a characteristic not before recorded for this species. Bremekamp (1955a) mentions a specimen of a possible new species, (*Korthals* from Sumatra, in L) which possesses "small teeth along the margin of the bracts", but has in addition the abaxial bracteoles "pectinate". In Australian material there is no evidence of the abaxial bracteole being pectinate and as the upper flowers in the spike all have normal bracts with entire margins, it is possible that the lowest flowers are subtended by depauperate spiny leaves rather than the usual entire bracts.

2. Bremekamp (1955a) in his treatment of the genus for Malesia recognized two subspecies under *A. ilicifolius*, ssp. *ilicifolius* from western Malesia and ssp. *orientalis* from eastern Malesia. These are distinguished as follows (differences extracted from Bremekamp's subspecies descriptions):-

Bracts and bracteoles spinosely mucronate, distinctly keeled, the bracts lanceolate, at least as long as bracteoles. Calyx segments mucronate, the posticous 5-nerved, the laterals 3-nerved, and the anticus 6-nerved, anticus segment linear-lanceolate, others lanceolate ..... ssp. *ilicifolius*

Bracts and bracteoles mucronulate or subobtusate, rounded at back, the bracts ovate-lanceolate, slightly shorter than bracteoles. Calyx segments mucronulate or subobtusate, the posticous 3-nerved, the laterals 1-nerved and the anticus 4-nerved, the anticus segment ovate-lanceolate, the posticous and lateral ovate ..... ssp. *orientalis*

On a distributional basis our material should belong to *A. ilicifolius* ssp. *orientalis*. As I have not seen material from eastern Malesia I cannot comment on how valid Bremekamp's differences are, but in the majority of Australian specimens the bracts are of similar size or slightly longer or shorter than the bracteoles, they sometimes (*McKean B715*) are spinosely mucronate and appear to be keeled and calyx segments are usually more or less obtuse at the apex and ovate in shape. Therefore, some characteristics of both subspecies seem to be present. Only a study of specimens from a wider area can resolve whether the differences cited by Bremekamp apply.

3. In the Malay Peninsula, Ridley (1923) states that the "fine large azure blue flowers of *A. ilicifolius*, more than twice as big as those of the white-flowered, more rarely bluish, *A. ebracteatus*, distinguish the two [species] at first glance". However, there would appear to be a gradation in flower size of *A. ilicifolius* elsewhere. Flowers from the Malesian area are 3.5-4 cm long (Bremekamp 1955), those from Java are 3-4.5 cm long (Backer 1965), while New Guinea and Australian flowers are 2.2-3 cms long. Accompanying this smaller corolla size are smaller corolla tubes, filaments, anthers, styles and calyx segments (see Table 8). The lengths of floral parts in Australia approach those recorded for *A. ebracteatus* in Malesia and this may have contributed to a reluctance in the past (e.g. Bentham 1868) to distinguish *A. ebracteatus* from *A. ilicifolius*.

#### *Representative specimens examined* (c. 105 specimens seen)

NORTHERN TERRITORY: *Adams s.n.*, 6.x.1965, Beatrice Hill (NT); *R.M. Barker 407*, 4.v.1983, Rapid Ck, behind Darwin Community College, Darwin (AD); *Blake 16973*, 11.ix.1946, Adelaide River (BRI); *Byrnes 1205*, 9.xii.1968, Adelaide R, near bridge (DNA, NT); *Hearne ?1613*, 31.x.1972, Adelaide R, at Humpty Doo Landing (DNA); *Holtze 270 p.p.*, 1883, Port Darwin (MEL); *Levitt 387*, 28.ix.1974, Wallaby Swamp, Groote Eylandt (DNA); *Morgan 63*, 21.ii.1971, Adelaide R, Mt Bundy Rd (DNA, NT); *Rankin 2425*, 20.vi.1980, Adelaide R, Arnhem Highway (ADW, DNA, NSW); *Specht 807*, 3.viii.1948, Yirrkala (BRI, CANB, MEL, NSW); *Telford 7472 & Wrigley*, 17.iv.1980, Adelaide River at Arnhem Highway crossing (CBG); *Wightman 82*, 1.x.1982, Adelaide River, Arnhem Highway crossing (AD, DNA).

QUEENSLAND: *Anon. s.n.*, 1904, Bellenden Ker Expedition. Goongoongoor (BRI 111215); *Cameron 2644*, 18.xii.1976, Badu Island, Torres Strait (QRS); *Crome M6* (QRS), 292 (CANB), 28.i.1972, Nind's Ck, near Innisfail (CANB, QRS); *Dietrich 634*, s. dat, Rockhampton (MEL); *Dietrich 1790*, 1864-66, Rockhampton (AD, CANB, MEL, NSW); *Dietrich 2159*, s. dat, Rockhampton (MEL); *Jacks s.n.*, 23.vi.1976, Cooper Ck, Daintree area (BRIU S-6187a); *Jones s.n.*, viii.1959, Cucania (BRI 111216 & 134027); *Jones s.n.*, xi.1966, Somerset, Cape York (BRI 111226 and BRI 111327); *Kenny s.n.*, 7.ii.1912, Mourilyan Harbour (BRI 111219); *McDonald & Batianoff 1810*, 31.viii.1976, Unnamed Creek, 1 km S of Hay Pt, 20 km S of Mackay (BRI, CANB); *Macnae 12.6*, 11.ii.1962, Lucinda Pt (BRI); *Mueller 107*, s. dat, Burdekin Expedition (MEL 602037); *Rasmussen s.n.*, 21.x.1963, on mangrove flats of Greta Ck, ca. 5 miles S of Longford Ck, Bowen Rd (BRI 043514); *Scarth-Johnson 253a*, viii.1976, Annie River, Marina Plains (BRI); *Smith 10201*, 10.ix.1967, Clump Pt, Bingil Bay (BRI); *Thorsborne s.n.*, 16.ix.1968, North Brook Island (BRI 077915); *Webb 911*, 13.ix.1945, Innisfail (BRIU, CANB); *Whaite 3655*, 31.viii.1979, Smalleys Beach near Cape Hillsborough (BRI, NSW).

NEW CALEDONIA: *Compton 656*, s. dat. Without locality (NSW); *Webster & Hildreth 14821*, 15.viii.1968, Banks of River Hienghene, 2 km S of Hienghene village (NSW).

NEW HEBRIDES: *Staer s.n.*, ii.1903, (NSW 37).

PAPUA NEW GUINEA: *van Royen NGF 16322*, 18.vi.1963, Solomon Sea Beach, E of Voco Point, Morobe District, (NSW).

PHILIPPINES: *Elmer 5648*, ii.1904, Bauang, Province of Union, Luzon (NSW); *Merrill (Species Blancoanae 636)*, x.1913, Manila, Luzon (NSW).



2. *Acanthus ebracteatus* Vahl, Symb. 2 (1791) 75, t. 40; R. Br., Prodr. (1810) 480; Benth., Fl. Austral. 4 (1868) 548; Domin, Biblioth. Bot. 89 (1929) 603; J. Green, Census Vasc. Pl. W. Austral. (1981) 95.

*Syntype*: Koenig *s.n.*, s. dat. In India Orientali. (Herb. Vahl — microfiche AD).

*Dilivaria ebracteata* (Vahl) Pers., Syn. Pl. 2 (1806) 179; Nees in A. DC., Prodr. 11 (1847) 269. Not used with respect to Australian collections.

Spreading shrub, or rarely herb to 2-3 m high, often scandent, more rarely creeping on ground (*Stone & Streimann LAE 53600*), with or without axillary spines. *Leaves* with petioles 5-25 mm long, blade ovate 6-23 x 2.5-7.5 cm, entire or holly-like by dentate margins, leathery, glabrous, gland-dotted, with apex and, when present, teeth acute or spine-tipped. *Inflorescence* an erect spike, flowers overlapping or not; peduncle usually without transverse ridges. *Bract* sessile, orbicular, 3-8 mm long, ciliate along margin, glabrous externally, internally with or without short pubescence; apex obtuse. *Bracteoles* usually absent, if present smaller than bract, 3-4 mm long. *Calyx* lobes 7-11 mm long, glabrous externally, ciliate, internally shortly pubescent; apex notched or obtuse. *Corolla* 1.5-3 cm long, white to pale blue with red to purple stripe in middle of lower lip, more rarely dark blue or purple, sometimes scented; tube 5-8 mm long, thickened and with ring of hairs at top at point of insertion of stamens; lobes glabrous externally, shortly appressed pubescent internally. *Stamens* with filaments of almost equal length, 7-12 mm long, cream, with abaxial pair somewhat wider than adaxial; anthers maroon, purple or brown; adaxial pair with dense, stiff, white hairs along suture and dorsally becoming more or less glabrous apart from a few sparse, villous hairs in a line to one side of mid line, abaxial pair with suture on at least one side with erect, stiff white hairs (tooth-brush like) or both sides glabrous, dorsally with villous, eglandular hairs arranged longitudinally and to one side of midline, in Australia without sessile glands on dorsal surface of abaxial pair of stamens, (but present on some Solomon Island specimens [*Whitmore BSIP 882 and Chapman 403*]). *Ovary*: style 10-20 mm long, notched at apex. *Capsule* 1.5-2.5 cm long. *Seed* c. 10 x 7 mm, yellow, closely rugose. Fig. 1 E-H.

### Typification

The only collection cited by Vahl (1791) is that of Koenig from east India, of which there is a specimen in Herb. Vahl (seen on microfiche in AD). This specimen is almost certainly the basis for the illustration (pl. 40) accompanying the protologue. Careful perusal of the plate indicates that both bracts (hence 'ebracteatus?') and bracteoles are lacking and so from this it is impossible to say whether the specimen is really *A. ebracteatus* as it is defined in Malesia. However, the flower size given by Vahl in the protologue (c. 2.5 cm) is consistent with that given for Indian collections of *A. ebracteatus*, as in India the flowers of *A. ebracteatus* are much smaller than those of *A. ilicifolius*, the other species to which the Koenig collection could be referred. This flower size difference does not occur in Australia, where the flowers of both species are 2-3 cm long. Another character mentioned by Vahl in his description of *A. ebracteatus* is the presence of cicatrices (transverse ribs) on the peduncle; in Australia these have been found only in *A. ilicifolius*.

Even though it seems likely that the Koenig collection is *A. ebracteatus* as it is usually understood in Malesia, this needs to be confirmed.

### Distribution

*A. ebracteatus* is a mangrove species found from India through to Polynesia.

### Ecology

The species is found at or near sea-level on the edges of mangrove communities, where it often forms thickets. Flowering specimens have most commonly been collected between October and February, but there are records outside these months.

### Note

The description of *A. ebracteatus* given above is based on Bremekamp (1955), Backer (1965) and specimens from New Guinea and Australia. Table 8 (p. 66) indicates the differences between the Australian and New Guinea material compared with that from Malasia. From this it can be seen that they differ with respect to bract size (3-6 mm long in Malasia vs 6.5-8.2 mm long for Australia and New Guinea), while Australian collections differ from those from Malasia and New Guinea by the absence of axillary thorns in all specimens, flower colour (blue-purple vs white or pale blue) and the possession of a pair of anthers with sutures which are glabrous on both sides.

Mostly on the basis of the glabrous anther sutures the Australian specimens have been referred to a new subspecies. Further collections are required with careful observation of flower colour and scent, the presence or absence of axillary spines, and habit of the plant. Backer (1965) notes that the holly-like leaves occur in sunny locations and entire leaves in well-shaded localities, but it is not known whether this is so in Australia.

It should also be noted that within the New Guinea material, particularly that from Manus Island, there seems to be a tendency for entire-leaved, creeping herbs with drooping, rather than erect, inflorescences, and within the Solomon Islands, flowers which are sometimes noticeably scented while others are recorded as lacking any perfume at all. A revision of the species throughout its entire range may indicate whether these New Guinea collections are deserving of any taxonomic status.

### Key to subspecies of *A. ebracteatus*

- 1a. Anther cells of the larger abaxial pair of stamens with sutures completely glabrous. Bracts 6.5-8.2 mm long. Flowers blue-purple, dark blue, purple or lilac ..... ssp. *ebarbatus*
- 1b. Anther cells of the larger abaxial pair of stamens with stiff erect hairs along one or both sides of the suture. Bracts 3-6 mm long, only in New Guinea 6.5-8 mm long. Flowers white or pale blue with blue margins ..... ssp. *ebracteatus*

### 1. ssp. *ebracteatus*

*Bracts* 3-6 mm long, in New Guinea 6.5-8 mm long. *Corolla* white to pale blue, red to purple stripe in middle of lower lip. *Stamens*: filaments 7-12.5 mm long; anther cells of abaxial pair with suture with at least one side with erect, stiff white hairs (toothbrush-like).

### Distribution and ecology

Ssp. *ebracteatus* is found in mangrove communities from India to Polynesia. Fig. 6.

### Specimens examined

NEW GUINEA: *Brass* 21702, 27.iii.1953, Menapi, Cape Vogel Peninsula (LAE); *Brass* 27712, 16.viii.1956, Joe Landing, Sudest Island (LAE); *Coode & Katik NGF* 29838, 15.ii.1967, Kaut Harbour, New Ireland (LAE, NSW); *Croft LAE* 65532, 11.x.1974, Mamirum Harbour, N Coast Lavongai, New Hanover (LAE); *Darbyshire* 623, 9.vii.1962, c. 5 m SW of Kanosia Plantation, Kairuku Subdistrict, Papua (LAE); *Foreman & Katik LAE* 59296, 5.xi.1974, near Pelikawa, Manus (LAE); *Gray & Floyd NGF* 8031, vii.1955, Uramu Island, N side (LAE); *Gillison NGF* 25393, 13.x.1966, Ramboro, Tagula Island, Milne Bay District (LAE); *Henty NGF* 27119, 8.xi.1965, W Point, Sudest Island, Milne Bay District (LAE); *Lelean & Streimann LAE* 52543, 21.x.1971, Sewa Bay, Normanby Island (LAE); *Hoogland* 4186, 24.vi.1954, near Komabun Village, Tufi subdistrict (LAE); *McKee* 1669, 17.xii.1954, Merauke, Irian Jaya (NSW, LAE); *Pullen* 3508, 13.viii.1962, Rubberlands Estate, Galley Reach area, Kairuki

Subdistrict, Papua (LAE); *Schodde & Craven 4203*, 9.i.1966, Kerema Bay, c. 5 m NW of Kerema, Gulf District (LAE); *Stefels BW 3172*, 28.ix.1956, Sjiirnoesoe Island, Argoeni Bay, Irian Jaya (LAE); *Streimann & Lelean LAE 51943*, 20.x.1971, Alotau, Milne Bay District (LAE); *van Royen 3091*, 20.iii.1954, Sorong, Roefi River, N of town (LAE); *Womersley NGF 2931 & NGF 2935*, 24.xii.1947, Morobe (LAE).

PHILIPPINES: *Elmer 12408*, v.1910, Magallanes (Mt Giting Giting), Capiz Province, Sibuyan (NSW); *Elmer 15703*, iv.1916, Irosin, Mt Bulusan, Sorsogon Province, Luzon (NSW); *Ramos & Edano s.n.*, v.vi.1918, Capiz, Capiz Province, Panay (NSW); *Weber 1035*, iii.vii.1911, Butuan Sub-province, Mindanao (NSW).

SOLOMON ISLANDS: *Beer BSIP 7752*, 1.xii.1965, SW of Paehena Pt, NW Santa Ysabel (LAE); *Chapman 403*, 15.i.1961, Mouth of Jaliri River, N Vangunu Island, New Georgia Gp (LAE); *Hunt 2749*, 28.ix.1965, Santa Ysabel, Regi-Tanabuli villages (LAE); *Inimua BSIP 6005*, 5.ii.1965, Nanienbuli, Reef Islands (LAE); *Maenu'u BSIP 6005*, 15.vi.1965, Tita River, SE New Georgia (LAE); *Maenu'u BSIP 6143*, 21.vii.1965, Jalire, Vangunu Island, New Georgia (LAE); *Runikera BSIP 13216*, 7.iii.1969, Kupala Pt, NW Shortland (LAE); *Sore, Masu'u & Lipaqueto BSIP 2634*, 11.vii.1963, Allardyce Harbour (LAE); *Susui BSIP 8349*, 22.xi.1967, Allardyce Harbour, Santa Ysabel (LAE); *Teona BSIP 6262*, 10.ii.1965, Moli, Uluwa Island (LAE); *Whitmore BSIP 882*, 29.xi.1962, Vangunu, S.E. Coast. New Georgia Gp (LAE); *Whitmore BSIP 1467*, 16.ii.1963, Merusu Cove, W coast of Kolombangara Island, New Georgia Gp (LAE).

### ssp. *ebarbatus* R.M. Barker, ssp. nov.

Subspecies nova *A. ebracteata*, a ssp. *ebracteata* differt bracteis maioribus (6.5-8.2 mm longis) et suturis glabris antherarum staminum abaxialium parium.

*Holotype*: *Martensz & Schodde AE 743*, 5.ii.1973, East Alligator River (CANB); *Isotypes*: (DNA, NT).

*Bracts* 6.5-8.2 mm long. *Corolla* blue-purple, dark blue, purple or lilac. *Stamens*: filaments 10-11 mm long; anther cells of abaxial pair with sutures completely glabrous. Fig. 1 E-H.

### *Distribution*

Only a few collections have been made from coastal rivers of Arnhem Land, Cape York Peninsula and Wyndham, in northern Australia. Fig. 6.

### *Ecology*

This subspecies is found associated with mangrove forests but often on their edge in areas subject to inundation by tidal rivers or the sea. Flowering specimens have been collected between October and February.

### *Notes*

1. The number of collections of this taxon is small and more material is desirable to determine variability. It is obviously closely related to typical forms of *A. ebracteatus* but differs in the possession of a pair of anthers with glabrous sutures. Other characters which may prove useful, but which are inadequately known at this stage are flower colour, presence or absence of axillary spines, and bract and calyx size (Table 8). From Table 8 it can be seen that New Guinea material assigned to *A. ebracteatus* agrees very closely with ssp. *ebarbatus* except for some sutures being pubescent.

2. *Hunt 2749* from Santa Ysabel, British Solomons, here assigned to ssp. *ebracteatus*, approaches ssp. *ebarbatus* by one of its anther pairs having sutures glabrous for  $\frac{3}{4}$  of their length. The other flower on the specimen has, however, sutures with hairs along the entire length, although they are shorter (0.2 mm long) than usual.

3. The lack of hairs along the sutures of two of the anthers and the lack of the sessile glands on the backs of two of the anthers (cf. Note 2 under genus p. 67) may point to a different pollinator in the case of ssp. *ebarbatus*. Pollen appears to be similar in shape in the two species, but has not yet been closely examined.

*Specimens examined*

NORTHERN TERRITORY: *Henne s.n.*, s. dat. Sweet's Island (K); *Henshall 845*, 24.x.1974, Peron Island (CANB, DNA, NT); *Henshall 3864*, 20.x.1981, White Star Landing on Glyde River (NT); *Martensz & Schodde AE 743*, 5.ii.1973, East Alligator River (DNA, CANB, NT); *Reeve & Goruna 551*, 8.i.1973, Goyder River (CANB); *Wells s.n.*, 30.ix.1178, Tomkinson River, Arnhem Land (CANB — 2 sheets).

QUEENSLAND: *Henne s.n.*, s. dat. Albert River (K, MEL 601744, MEL 601745); *Tucker 50*, 3.ii.1979, South bank of Wenlock R about 2 miles upstream from Batavia Landing (QRS).

WESTERN AUSTRALIA: *Smith & Johnstone s.n.*, 12.xi.1977, King Creek, Wyndham (PERTH — 2 sheets).

*Specimens possibly of ssp. ebarbatus*

NORTHERN TERRITORY: *Brown s.n.*, 1802-5, Carpentaria (MEL 602052); *Craven 4001*, 1.vi.1976, Mugg's Mistake, McArthur River (CANB); *Wells s.n.*, 15.vi.1979, Habgood River, Arnhem Bay (DNA 15239).

3. *Acanthus* cf. *mollis* L., Sp. Pl. (1753) 639; Eichler, Suppl. Black's Fl. S. Austral. (1965) 284; Curtis, Students Fl. Tasmania 3 (1967) 539; Willis, Hdbk Pl. Vict. 2 (1973) 575.

*Types*: From Italy and Sicily; Herb. Cliff. — BM (n.v.); fide Hossain 1982.

Perennial with leaves in basal rosette, c. 0.5 m high, c. 1 m diameter, with tuberous roots. *Leaves* with axillary spines absent and stiff, reclining, glabrous petioles to 20-30 cm long, blade to 50 cm long and 30 cm broad, margins divided or incised, deeply lobed/toothed, sometimes segments or teeth spine-tipped, dark glossy green, glabrous, without glands. *Inflorescence* an erect spike arising from basal leaf rosette, to 2 m long, devoid of flowers towards base; rachis glabrous (*R.M. Barker 630*) or pubescent (*Assistant Agronomist BRI 043512*), without transverse ridges. *Bracts* cuneate at base, 3-3.5 x 1 cm, finely pubescent all over, 4-5 (-7) spiny teeth on each side of midrib, 5 main veins arising from base. *Bracteoles* lanceolate, c. 2 cm long, pubescent. *Calyx* with outer lobes unequal, upper functioning as upper lip of corolla, c. 4 cm long, lower c. 3 cm long, both finely pubescent, entire and apically notched, purple or purple-tinged; inner lobes ovate, c. 6 mm long, with acute apex and pellucid margin. *Corolla* c. 4-4.5 cm long, white; tube thickened at top, ring of dense upright hairs at point of insertion of stamens, hairs continuing onto base of lower lip, continuing for short distance onto lateral lobes, rest of corolla glabrous or (*Gaff s.n.*) corolla pubescent all over. *Stamens* with filaments curved, c. 20-25 mm long; anthers purple or maroon, 8-10 mm long, abaxial pair without sessile glands on dorsal surface, with long, erect, white hairs on either side of suture, adaxial pair with shorter, erect, white hairs along one side of suture, a line of villous, white hairs to one side of dorsal surface. *Ovary* glabrous except for stiff, white eglandular hairs at apex and on base of c. 2.8 cm long style; stigma distinctly 2-notched. *Capsule* unknown from cited specimens, but from cultivated specimens (ex AD), c. 2 cm long, mucronate at apex, this mucro with a few sparse hairs at base, 1-2-seeded. *Seed* brown, c. 14 x 8 mm, surface smooth, shining.

*Distribution*

*A. cf. mollis* was introduced as a garden plant and has become naturalised at least in South Australia, Victoria, Tasmania and Queensland, where it is likely that because of its ability to reproduce from root fragments it has persisted in areas which were formerly gardens. No material has been seen from Victoria and Tasmania, but occurrence of the species is recorded in Willis (1973) and Curtis (1967) respectively.

### Note

The material cultivated in Australian gardens is referred to *A. mollis* with some reservation. Australian specimens differ from the usual descriptions of this species by the possession of pubescent bracts and calyces, the usually glabrous peduncle and glabrous leaves, and from the type by the incised rather than pinnatifid leaves. Rix (1980) described the extremes of *A. mollis* and *A. spinosus*, another Linnaean species from Italy, as very distinct, but said there were apparently many intermediate forms between these two species and that these have persisted in gardens. It is possible that Australian material belongs with these transitional forms, particularly as *A. spinosus* has also been recorded for South Australian gardens (Francis 1859, Schomburgk 1871). At this stage there is very little material on which to base a description for Australia and this, combined with a certain amount of confusion over the status of some of the European and African species (Heine 1962), causes uncertainty about the specific name. It is possible that material seen from Queensland is a different taxon from that seen from South Australia but again the paucity of collections and also the fact that collections are often only vegetative does not allow for close comparisons at this stage.

### Specimens examined

QUEENSLAND: *Assistant Agronomist s.n.*, 6.iii.1951, Kingaroy (BRI 043512); *Gaff s.n.*, 4.xi.1963, Wynnum (BRI 043493, BRI 043494); *Sigley s.n.*, 2.viii.1963, Mt Tamborine, property of W.A. Allen, Westcliff Rd (BRI 041267).

SOUTH AUSTRALIA: *R.M. Barker 630*, xi.1983, Upper Sturt Rd, near Belair Railway Stn entrance (AD); *Booth 181*, 29.viii.1958, W side of Kalangadoo-Glencoe road, under trees at S end of Lover's Lane (AD).

CULTIVATED MATERIAL: SOUTH AUSTRALIA: *R.M. Barker & L. Haegi 631 & 634*, iii/iv.1984, Adelaide Botanic Garden (AD); *Grivell 460*, 4.xii.1968, Wittunga Botanic Garden, Blackwood (AD); *Schomburgk s.n.*, s. dat. Adelaide Botanic Garden (AD); *Swinbourne s.n.*, 11.i.1967, Class grounds, Adelaide Botanic Garden (AD).

## 5. RUELLIA L., s. str.

Plants of this genus, taken in its narrowest sense, are often cultivated and are chiefly American in origin. There are at least two species which have been introduced into Australia and which now appear to have become naturalised. Both *Ruellia tuberosa* and *Ruellia* aff. *malacosperma* fall within the delimitation of *Ruellia* s. str. while there is a third introduced species which has sometimes been referred to *Ruellia*, *R. graecizans* Backer, but this is treated here under *Stephanophysum longifolium* Pohl.

*Ruellia* L., Sp. Pl. edn 1 (1753) 634 p.p.; L., Gen. Pl. edn 5 (1754) 702, p.p.; Benth. & Hook. f., Gen. Pl. 2 (1876) 1077 p.p.; Lindau, Engler & Prantl, Nat. Pflanzenfam. IV, 3b (1895) 308; Bremek. & Nannenga-Bremek., Verh. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. 45 (1948) 8; Long, J. Arn. Arb. 51 (1970) 285 p.p.

*Lectotype species*: *R. tuberosa* L. (see Britton & Brown, Ill. Fl. N. United States edn 2, 3 (1913) 241) from the West Indies.

*Cryphiacanthus* Nees, Linnaea 16 (1842) 298.

*Type species*: *C. barbadensis* Nees = *Ruellia tuberosa* L.

Herbs with cystoliths, often with long thin tuberous roots. *Branches* constricted above nodes. *Leaves* petiolate, opposite pairs connected by transverse ridge. *Inflorescence* an axillary, long peduncled dichasium; flowers large and showy (chasmogamous), or cleistogamous. *Bracteoles* shorter than calyx, *calyx* segments long-linear, equal. *Corolla* with narrow tube expanding into funnel-shaped, ventricose throat at angle to tube; lobes 5, equal, spreading, contorted in bud. *Stamens* 4, didynamous, inserted at top of corolla tube, included in throat,

pressed against adaxial surface together with style; staminodes ? absent; filament pairs connected at base by membrane; anther cells 2, linear, equal, inserted at same height, sometimes mucronate at base. *Disc* annular. *Ovary* with (in Australia) 10-13 superposed ovules per cell; style included, with one stigmatic lobe flattened, somewhat crenulate, glabrous, much larger than the rudimentary second lobe. *Capsule* erect, fusiform, exploding violently and flinging out seeds, seed-bearing throughout but for the very base, c. 20-seeded; seed-bearing hooks prominent. *Seed* discoid, appearing more or less glabrous when dry, covered all over by a dense mat of mucous hairs which expand and spread outwards on exposure to water.

### *Distribution*

*Ruellia* s.s. consists of only about five species confined to Central and South America, but with at least one of these species (*R. tuberosa*) a common tropical weed.

### Key to species of *Ruellia* naturalised in Australia

- 1a. Leaves ovate, 1.5-3.5 cm wide, 3.7-6 cm long. Calyx lobes glabrous or with sparse eglandular hairs. Anther backs hairy; anther cells not mucronate at base ..... 1. *R. tuberosa*
- 1b. Leaves linear-oblong to linear-lanceolate, 0.5-1.5 cm wide, up to 15 cm long. Calyx lobes with glandular hairs. Anther backs glabrous, anther cells with mucronate bases ..... 2. *R. aff. malacosperma*

1. *Ruellia tuberosa* L. Sp. Pl. (1753) 635; Leonard, J. Wash. Acad. Sci. 17 (1927) 509; Bremek. & Nannenga-Bremek., Verh. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. 45 (1948) 11; Leonard, Contrib. U.S. Natl. Herb. 31 (1951) 78; Long, Amer. J. Bot. 63 (1976) 951.

*Syntypes*: Jamaica (LINN 804.8, S262.3: microfiche AD).

*Ruellia clandestina* L. Sp. Pl. (1753) 634.

*Syntypes*: Barbados (LINN 804.4 and 804.5).

*Cryphiacanthus barbadensis* Nees, Indicem Seminum Horti Vratislav. A. (1841): (n.v.); Nees, Linnaea 16 (1842) 298; Nees in A. DC., Prodr. 11 (1847) 197, p.p.

*Type*: (not seen).

Annual herb, 40-60 cm high, erect, usually with 1-2 main branches; roots long thin tuberous. *Branches* 4-angled, often grooved, more or less glabrous, or with hairs on opposite pair of 4 faces. *Leaves* with petioles c. 1.5 cm long; blade ovate, largest leaves c. 3.7-6 x 1.5-3.5 cm, attenuate at base, crenulate on margins, rounded at apex, glabrous or very sparingly hairy, covered with small cystoliths. *Inflorescence* axillary, long pedunculate dichasium with lateral flowers sometimes cleistogamous. *Peduncle* c. 1.8-3.4 cm long, glabrous. *Bracteoles* narrow-linear, smaller than or equal to pedicel, sometimes in cleistogamous flowers equal to ½ length of calyx. *Pedicel* 1-6 mm long, glabrous. *Calyx* segments c. 14.5-20.5 x 0.5-1.0 mm at maturity, ?smaller (c. 10 x 0.6 mm) on cleistogamous or lateral flowers, glabrous or with sparse eglandular hairs externally, dense shiny appressed hairs internally. *Corolla* of chasmogamous flowers blue to mauve, darker in throat, tube 10-12 mm long, externally hairy towards apex; throat slightly oblique to tube, 22-25 mm long, externally hairy, internally glabrous; lobes 16-17 mm long, spreading; corolla of cleistogamous flowers 4-5 mm long, terete, constricted just above base, fugacious; lobes ciliate, not spreading. *Stamens*: filaments of two lengths, c. 8.5 mm and 4.3 mm long, glabrous except for short hairs along ridge below point of attachment of longer pair; connective apex not exceeding anther cells; anthers white, cells hairy on their dorsal surface, not mucronate at base. *Ovary* in chasmogamous flowers glabrous but for few glandular hairs at apex, each cell with c. 13 ovules

in 2 rows; style pale blue, c. 21 mm long, sparsely eglandular hairy; stigma c. 1.9 mm long; in cleistogamous flowers with ovary glabrous, stigma sessile. *Capsule* 18-23.5 mm long, glabrous except for a few glandular hairs on light-coloured, arrow-shaped area at apex, c. 20-26 seeded, exploding on contact with water. *Seeds* 2.1-2.5 mm diameter.

### Distribution

Within Australia there are collections of *R. tuberosa* from the Darwin area and from Townsville; in both areas it has become naturalised. *R. tuberosa* originates from the West Indies and northern America. Fig. 7.

### Ecology

*R. tuberosa* collections from Australia have come from gardens and also from waste places in urban areas. As early as 1920 a collection was made from the Darwin Botanic Garden with the comment that it was "a troublesome weed . . . very common and hard to eradicate" (Allen 453). Its very efficient seed dispersal, the tuberous roots and mucilaginous hairs on the seeds which serve to anchor the seeds on the substrate when they dry no doubt contribute to this, along with its flexible pollination system (see below).

### Notes

Scott (1872) documented the behaviour of the small cleistogamous flowers of this species, although their nature had already been recognised by Linnaeus (in the name *R. clandestina*). In his studies on the species in Calcutta Botanic Garden, Scott attributed the large flowers to the cold season and the small self-fertile flowers to the hot season and observed that the "fertility of the self-fertilized and closed flowers is as a rule considerably higher than the natural fertility . . . of the fully developed and open flowers. The capsules of the closed flowers are from 10-13 lines long, and very regularly contain 18-24 seeds; whereas we have seen those of the large flowers contain only some 8 or 10 seeds".

The Australian material seems to show variance to this statement in that both types of flowers are usually found together. The capsules are 20-26-seeded, but whether they arise from the large or small flowers is not distinguishable from a study of herbarium material.

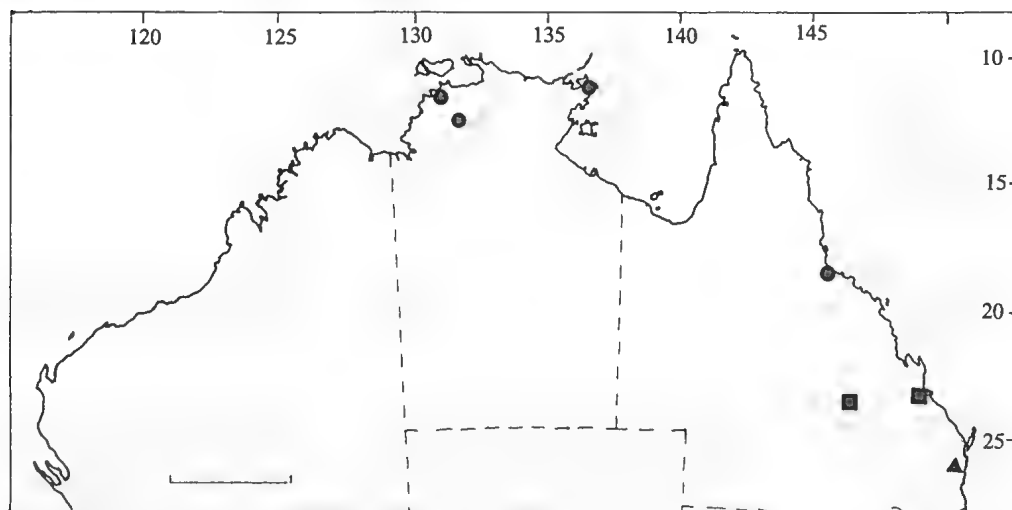


Fig. 7. Distribution of introduced *Ruellia* and *Stephanophysum* in Australia — naturalised localities. (● *R. tuberosa*; ■ *R. aff. malacosperma*; ▲ *S. longifolium*).



*Specimens examined*

NORTHERN TERRITORY: *Allen 453*, ii.1920, Botanic Gdns, Darwin (NSW); *Anon s.n.*, ii.1970, Gove (NSW); *R.M. Barker 346*, 29.iv.1983, Caravan Park, Pine Creek (AD); *R.M. Barker 393*, 1.v.1983, Elizabeth River, Stuart Hwy, 33 km S of Winellie P.O. (AD); *Morgan s.n.*, 10.ii.1971, Wood St., Darwin (DNA 3711); *Muspratt SSO 300*, 1.ii.1963, Darwin (DNA); *Nelson 1080*, 9.vi.1964, Animal Industry Branch, Mitchell St., Darwin (NT); *Pickering 59*, 6.ix.1965, 3 m N of Darwin (NSW, NT); *Stephens s.n.*, 2.iii.1954, Darwin (BRI 293190).

QUEENSLAND: *James s.n.*, 24.iii.1976, Townsville (home garden) (BRI 207855); *Wilson s.n.*, ii.1960, Townsville, naturalised in rough parkland in suburbs (BRI 024205).

## 2. *Ruellia* aff. *malacosperma* Greenm., Proc. Amer. Acad. Arts & Sci. 34 (1899) 572.

*Type: Pringle 6806*, Tampico, Tamaulipas, Mexico (herbarium unknown, n.v.).

Woody upright herb, 60 cm high, with simple 4-angled, glabrous branches; roots long, thin, tuberous. *Leaves* with petioles c. 1-1.5 cm long, linear-lanceolate, attenuate at base, margin undulate, acute, largest leaves to 15 x 0.5-1.5 cm, glabrous, covered with small cystoliths. *Inflorescence* long pedunculate, axillary, dichasia, with large conspicuous chasmogamous and small cleistogamous flowers. *Peduncle* to base of bracteoles, to 7 cm long, glabrous. *Bracteoles* linear, glabrous, not exceeding calyx, lowest to 12 mm long, becoming progressively smaller. *Pedicel* to 34 mm long for central flower of cyme, shorter for lateral flowers, glandular hairy mixed with a few eglandular hairs. *Calyx* segments c. 12-15.3 x 1-1.1 mm, externally glandular hairy mixed with sparse eglandular hairs, internally with dense appressed shining eglandular hairs. *Corolla* of chasmogamous flowers, blue; tube 10-13 mm long, externally hairy towards apex; throat ? at angle to tube, c. 20-22 mm long, externally hairy, internally glabrous; lobes c. 10-12 mm long, spreading; corolla of cleistogamous flowers c. 4 mm long, pubescent externally. *Stamens* with filaments of two lengths, c. 10 and 5.5 mm long, glabrous except for short hairs along ridge below point where longer filaments are attached to tube; connective slightly exceeding anther cells, with rounded apex; anther colour unknown, cells mucronate at base, glabrous on dorsal surface. *Ovary* of chasmogamous flowers glabrous apart from glandular hairs at apex, each cell with 13 ovules in 2 overlapping rows; style c. 22 mm long, sparsely eglandular hairy; larger stigma lobe c. 1.6 mm long; ovary of cleistogamous flowers unknown. *Capsule* 23-26 mm long, glabrous except for glandular hairs at apex, 18-20 seeded. *Seed* c. 2 mm diameter.

*Distribution*

*R. malacosperma* is a native of South America. Within Australia it has been recorded as a weed or garden escape from Brisbane, Gladstone and Springsure in Queensland, while it has also been collected from Boigu Island in Torres Strait. Fig. 7.

*Ecology*

This species is weedy because of its ability to sucker and the efficient dispersal of its seeds. So far all specimens seen have been from gardens in urban areas; collectors mostly comment on its nuisance potential.

*Note*

While the two species *R. malacosperma* and *R. brittoniana* are recognised as distinct in North and South America (Fernald 1945) the Australian material appears to occupy a position somewhere between the two (see Table 9). Both are frequently cultivated in the tropics and thus it is not impossible that the Australian specimens are of hybrid origin. The other alternative is that the species as recognized in America are not deserving of this status, but I am in no position to judge. In view of these inadequacies and the limited Australian material

available I have referred to the specimens as *R. aff. malacosperma*. Only a revision of the American species will enable the true relationships of the Australian specimens to be ascertained. Fernald (1945) discusses at length the distinctions between *R. malacosperma*, *R. brittoniana* and a third species *R. tweediana*, but the characters he cites separating these three species are not adequate to place the Australian specimens with certainty.

Character	<i>R. brittoniana</i>	Australian material	<i>R. malacosperma</i>
young parts	glabrous	few v. sparse hairs	villous-hirsute, becoming glabrate
leaves: shape	narrow linear-lanceolate	linear lanceolate	oblong or elliptic-lanceolate
length	30 cm long	up to 15 cm long	5-13 cm long
width	2 cm wide	1-2 cm wide	1-3 cm wide
calyx length	5-10 mm	6.5-17 mm	15-20 mm (Fernald) 13-15 mm (Durkee)
indumentum	glabrous to hirtellous	glandular hairy	glandular hairy
corolla length	2.5-4 cm	c. 4 cm	4.5-5 (Durkee) 3.5-5 cm (Fernald)
indumentum	glabrous to hairy	pubescent externally	glabrous externally
capsule length	2-2.7 cm	2.3-2.6 cm	2.5-3 cm (Fernald)
seed diameter	2-2.5 mm	2-2.4 mm	2.8-3.3 mm (Fernald)

Table 9: Comparison of Australian material assigned to *Ruellia* aff. *malacosperma* with American *R. brittoniana* and *R. malacosperma*. Measurements of American species from Fernald 1945 and Durkee 1978.

### Specimens examined

QUEENSLAND: *Caulfield s.n.*, 30.iii.1977, Brisbane Botanic Garden (BRI 220895); *Clarkson 3848*, 19.x.1981, Boigu Island (AD); *Elliot s.n.*, 30.i.1976, Gladstone, House allotment (BRI 204758); *McKey s.n.*, 1.i.1980, 60 Prince Street, Virginia, Brisbane (BRI 256603); *McLaughlin G33*, s. dat, Springsure (BRI); *McLaughlin s.n.*, vi.1953, "Buckleton", Springsure (BRI 1444426).

## 6. STEPHANOPHYSUM Pohl

The introduced species of this genus represents a new generic as well as specific record for Australia.

**Stephanophysum** Pohl, Pl. Bras. Icon. Descr. 2 (1830 or 31) 83 (n.v.); Endl., Gen. Pl. (1839) 700; Nees in A. DC., Prodr. 11 (1847) 101 & 201; Bremek. & Nannenga-Bremek. Verh. Ned. Akad. Wetensch., Afd. Natuurk, Tweede Sect. 45 (1948) 13; Backer, Fl. Java 2 (1965) 558.

*Type species: S. longifolium* Pohl. (Brazil).

*Ruellia* auctt non L.: Benth. & Hook. f., Gen. Pl. 2 (1876) 1077, p.p.; Lindau in Engl. & Prantl, Nat. Pflanzenfam. IV, 3b (1895) 308 p.p.; Backer, Brittonia 3 (1938) 85 p.p.

Upright herb with cystoliths. *Branches* contracted above node. *Leaves* petiolate, opposite pairs connected by transverse ridge. *Inflorescence* an axillary, long-peduncled cyme; ? all flowers chasmogamous. *Bracteoles* shorter than calyx. *Calyx* segments 5, long-linear, equal. *Corolla* tube narrow, expanding into campanulate, ventricose throat at angle to tube; lobes 5, short, porrect, more or less equal, contorted in bud. *Stamens* 4, more or less equal, slightly exceeding throat, in 2 pairs, bases of each pair connected by basal membrane; staminodes lacking; anthers 2-celled, cells equal, inserted at same height, sometimes shortly mucronate at

base. *Disc* annular. *Ovary* with (in Australia) 7 superposed ovules per cell; style just exerted from throat, one stigmatic lobe flattened, crenulate, glabrous, much larger than rudimentary second lobe. *Capsule* clavate, ? exploding violently when ripe, only middle part with to 14 prominent seed-bearing hooks. *Seed* discoid, mucous hairs confined to rim, these spreading outwards on exposure to water.

### *Distribution*

A few species confined to tropical America; some of these are cultivated in other tropical countries.

***Stephanophysum longifolium*** Pohl, Pl. Bras. Icon. Descr. 2 (1830 or 1831) 85, tab. 156 (n.v.); Nees in A. DC., Prodr. 11 (1847) 203; Nees in Martius & Eichler, Fl. Bras. 9 (1847) 50; Bremek. & Nannenga-Bremek., Verh. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. 45 (1948) 13; Backer, Fl. Java 2 (1965) 558. — *Ruellia longifolia* (Pohl) Griseb. ex Lindau in Engler & Prantl, Nat. Pflanzenfam. IV, 3b (1895) 311, nom. illeg. (predated by *R. longifolia* Rich., Acta Soc. Hist. Nat. Par. 1 (1782) 110).

*Type*: not located, but probably Pohl no. 3027 and 6038 in “herb. imp. vindobensis” (W).

*Echinacanthus dichotomus* O. Kuntze, Rev. Gen. Pl. (1891) 489; Lindau in Engler & Prantl, Nat. Pflanzenfam. IV, 3b (1895) 302.

*Type*: Kuntze 4389, v.1875, Buitenzorg (NY: n.v.).

*Ruellia amoena* Nees ex Jackson, Index Kewensis 4 (1894) 759; T.H. Everett, Addisonia 22 (1947) 55, tab. 732, nom. illeg. (predated by *R. amoena* Sesse et Moc., Pl. Novae Hisp. edn 1 (1889) 100).

*Ruellia graecizans* Backer, Brittonia 3 (1938) 85 (“nomen novum for *Stephanophysum longifolium* Pohl”).

Erect, perennial herb, or subshrub, to 30 cm high. *Branches* 4-angled, glabrous, often constricted above node, particularly in young parts, numerous cystoliths all over and tiny hairs on upper parts of plant. *Leaves* with petioles c. 2 cm long, blade ovate, to c. 6-8 x 2.4-3.9 cm, cuneate or attenuate at base, slightly crenulate on margins, acuminate or acute at apex, covered with cystoliths, bright green above, paler below, younger leaves minutely pubescent, glabrescent. *Inflorescence* axillary, long peduncled, dichasium. *Peduncle* to 6.5 cm long, covered with minute hairs. *Bracteoles* narrow-linear, less than calyx length, covered with minute hairs. *Pedicel* to 5 mm long on mature flowers, minutely pubescent. *Calyx* 8-11 x 0.6-0.7 mm, minutely pubescent all over. *Corolla* bright red externally and on inside of lobes, throat internally yellow with red venation; tube c. 1 cm long, minutely pubescent externally, glabrous internally except for 2 lines of mixed glandular/eglandular hairs decurrent from base of filaments; throat c. 2 cm long, curved slightly, minutely pubescent externally, glabrous internally; lobes c. 3-5 mm long, more or less equal. *Stamens* with filaments c. 11 mm long, glabrous; anthers 2-celled, cells spreading slightly, shortly mucronate at base, glandular hairy on back. *Ovary* constricted at base and apex, at base more or less fused to annular disc, 7 superposed ovules per cell, densely eglandular and glandular hairy on expanded ovulate portion; style minutely hairy, c. 23 mm long, ? becoming red towards apex. *Capsule* 13-14 mm long, with glandular and eglandular hairs all over, 5-13-seeded, each seed subtended by a well-developed hook. *Seed* c. 2.5 mm diameter.

### *Distribution*

Only 2 collections of this species were seen, one from Brisbane Botanic Gardens (cultivated) and the other from Nambour, Queensland, where it was recorded as a naturalised weed. It originates from Brazil, but is widely cultivated as an ornamental plant throughout the tropics and as an indoor plant in Europe and North America. Fig. 7.

### Ecology

The collection from Nambour (*Lanham 590*) is from "kikuyu pasture on heavy clay loam" and is said to be the first record of *S. longifolium* naturalised in Queensland. Since the seeds are reputed to germinate easily and root cuttings are also easily established (Everett 1947) there is potential for it to become more widespread.

### Note

Types of this species and its synonyms have not been seen. The description is based on the two specimens examined, but the synonymy, once the species and genus had been established, relies chiefly on the comprehensive discussion by Backer (1938) and Bremekamp & Nannenga-Bremekamp (1948). Should the species be transferred to *Ruellia* then the epithet for the species would be *Ruellia graecizans* Backer, a new name proposed by Backer (1938) because all other possible epithets (*dichotomus*, *longifolia* and *amoena*) had already been used for different taxa within *Ruellia*.

### Specimens examined

QUEENSLAND: *Caulfield s.n.*, 15.iii.1977, Brisbane Botanic Gardens (BRI 220897); *Lanham 590*, i.1973, 3.2 km N of Nambour, Image Flat Rd, Kiamba on property of N.F. Duhs (BRI).

## 7. DIPTERACANTHUS Nees

As has already been stated *Dipteracanthus* is sometimes recognised as a section or subgenus of *Ruellia*. The first species described from Arnhem Land was *Ruellia bracteata* by Robert Brown (1810). This species is somewhat atypical of the genus in possessing flowers with the typical moth-pollination characters of exerted style and stamens and being night-flowering; it was only dubiously included under *Dipteracanthus* by Nees von Esenbeck (1847a).

Mueller (1859) described *Dipteracanthus australasicus* from Queensland. Mueller (1867) changed his mind on this species, ascribing it instead to *Ruellia bracteata* (see *D. australasicus*, Typification) and annotating Queensland and central Australian specimens as either *Ruellia corynotheca* or *Ruellia primulacea*, epithets which were later taken up by Bentham (1868) and which have been used ever since.

Bremekamp (1948) resurrected the genus *Dipteracanthus* for Malesia, at the same time excluding American species which had been included by Nees von Esenbeck (1847a) in the only world wide treatment of the genus. In a paper in 1962 Bremekamp described a new species of *Dipteracanthus* for Australia, *D. sessiliflorus*, and made the combinations *D. primulaceus* and *D. corynothecus*. Unfortunately the combinations were invalidly published as Bremekamp neglected to cite a full reference to the author and original publication; nor did he see type material of *R. corynotheca* which is a much smaller flowered eastern Queensland taxon. Bremekamp used this epithet in annotating specimens of the much larger flowered central Australian taxon, the correct name for which, in the absence of the overlooked *D. australasicus*, should have been *D. primulaceus*.

W.R. Barker (1981) in his treatment for central Australia, saw specimens chiefly from NT and AD and found the diagnostic characters used by Bremekamp to be untenable. He preferred and validated *D. corynothecus* over *D. primulaceus* as the name of the combined species (the later named *D. sessiliflorus* having been reduced to a synonym), because of its predominance on the determined specimens, particularly those annotated by Bremekamp.

In the following work the name *D. australasicus* is reintroduced for the polymorphic widespread species.

**Dipteracanthus** Nees in Wallich, Pl. Asiat. Rar. 3 (1832) 81; Nees in A. DC., Prodr. 11 (1847) 115; Bremek., Ned. Akad. Wetensch., Verh. 45 (1948) 14; Bremek., Acta Bot. Neerl. 11 (1962) 195; W.R. Barker in Jessop, Fl. Central Austral. (1981) 336.

*Type species: D. prostratus* (Poir.) Nees from India.

Herbs or shrubs, with cystoliths, sometimes with thin tuberous roots. *Branches* thickened at nodes. *Leaves* and flower subtending bracts petiolate, opposite pairs connected by transverse ridge. *Inflorescence* of 1-2 (3) more or less sessile, rarely long pedicellate flowers in upper axils, combined into terminal raceme or spike; flowers large and showy, sometimes small and cleistogamous. *Bracteoles* 2, leaflike, longer than calyx. *Calyx* segments 5, equal, linear. *Corolla* tubular at base, widening into throat; lobes 5, equal, contorted in bud, spreading in flower. *Stamens* 4, didynamous, inserted at top of corolla tube, usually included, rarely exserted (*D. bracteatus*), sometimes accompanied by staminode; filaments connected basally in pairs by membrane; anthers 2-celled, cells inserted at same level, equal, no appendages at base. *Disc* annular with irregular rim. *Ovary* with 4-8 ovules in 2 rows in each cell; style longer than anthers, included or exserted; stigma glabrous, one lobe flattened and much larger than other. *Capsule* clavate, base without seeds, 1-16 seeded, when mature exploding violently on exposure to water; hooks well developed. *Seed* discoid, only the thickened rim with mucilaginous hairs which expand on wetting. Fig. 8.

#### *Distribution*

Without a revision of the genus it is difficult to estimate the size of *Dipteracanthus* as circumscribed here. Clarke (1885, under *Ruellia*) lists 9 species for India and 18 species for Africa, while Bremekamp (1948) lists 4 species for Malesia. Nees (1847a) recognised a total of 88 species throughout the world but the American species were excluded by Bremekamp. In Australia there are two species, one of these with 4 subspecies.

#### **Key to species of *Dipteracanthus* in Australia**

- 1a. Stamens and style included in corolla throat. Flowers more or less sessile. Corolla blue, mauve, purple or white, opening during the day; tube less than 10 mm long before widening into throat. Filaments hairy at least at base. Capsule glabrous ..... 1. *D. australasicus*
- 1b. Stamens and style exserted from corolla throat. Flowers long-pedunculate. Corolla white, cream or pale yellow, opening at night; tube 20-26 mm long before widening into throat. Filaments glabrous. Capsule with fine hairs at least in upper half ..... 2. *D. bracteatus*

1. ***Dipteracanthus australasicus*** F. Muell., N.S. Wales Votes Proc. Legis. Assembly 2 (1859) 8; F. Muell., Appendix Journals J. McD. Stuart (1865) 502.

*Lectotype* here designated: *Anon. (Mueller) s.n.*, s. dat. Burdekin River (MEL 601752), *Isolectotype*: K. *Syntype*: *Anon. (Mueller) s.n.*, s. dat. Burdekin River (MEL 601756, K); see ssp. *corynothecus*; Gregory *s.n.*, 1858, Cooper's River (specimen not located).

*Ruellia corynotheca* F. Muell. ex Benth., Fl. Austral 4 (1868) 546 — *Dipteracanthus corynothecus* (F. Muell. ex Benth.) Bremek., Acta Bot. Neerl. 11 (1962) 195, *nom. invalid.* var. *grandiflorus* Bremek., Acta Bot. Neerl. 11 (1962) 195; *nom. invalid.* — *D. corynothecus* (F. Muell. ex Benth.) Bremek. ex W.R. Barker in Jessop, Fl. Central Austral. (1981) 336; see under ssp. *australasicus* and ssp. *corynothecus*.

*Ruellia primulacea* F. Muell. ex Benth., Fl. Austral. 4 (1868) 546. — *Dipteracanthus primulaceus* (F. Muell. ex Benth.) Bremek., Acta Bot. Neerl. 11 (1962) 196, *nom. invalid.*; see under ssp. *australasicus*.

*Dipteracanthus sessiliflorus* Bremek., Acta Bot. Neerl. 11 (1962) 196; Chippendale, Proc. Linn. Soc. N.S. Wales 96 (1971) 259; see under ssp. *australasicus*.

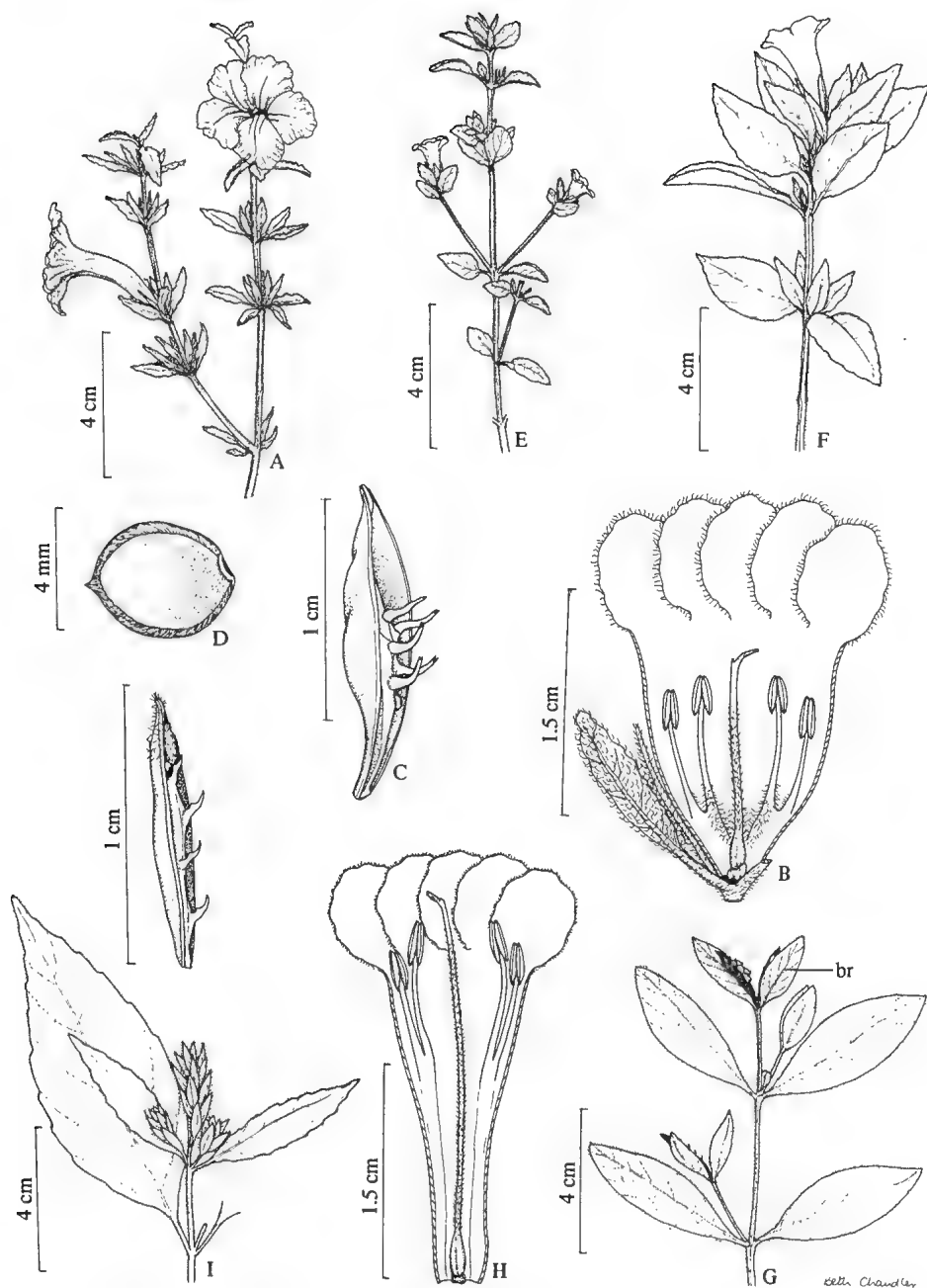


Fig. 8. A-D, *Dipteracanthus australasicus* F. Muell. ssp. *australasicus*. A, floral branches (W.R. Barker 2809); B, opened flower with bracteole (br) (W.R. Barker 2809); C, half capsule showing seed bearing hooks (Smith 6082); D, dry seed with appressed hairs about rim (Smith 6082). E, ssp. *corynothecus* (F. Muell. ex Benth.) R.M. Barker, branch (Verdon CBG 7803873). F, ssp. *dalyensis* R.M. Barker, branch (Byrnes NT 24322). G, H, *Dipteracanthus bracteatus* (R. Br.) Nees. G, branch with capsule surrounded by bracteoles (br) (Baker BRI 144328); H, flower (Hyland 9244). I, J, *Hemigraphis cf. royerii* Bemek. I, apex with leaves and inflorescence (Brass 19147); J, half capsule showing seed-bearing hooks (Webb & Tracey 8535).

*Ruellia bracteata* auct. non R. Br.; F. Muell., *Fragm. Phyt. Austral.* 6 (1867) 91 p.p. (as to specimens previously assigned to *Dipteracanthus australasicus*); Domin, *Biblioth. Bot.* 89 (1929) 603: *pro syn.*

*Justicia kempeana* auct. non F. Muell.: F. Muell., *Fragm. Phyt. Austral.* 11 (1880) 101 p.p.: see under ssp. *australasicus*.

Herb or shrub, usually erect, sometimes climbing, rarely prostrate; roots unknown. *Branches* more or less square in cross-section, with dense linear cystoliths parallel to branch axis, usually with eglandular hairs, rarely more or less glabrous. *Leaves* and flower subtending bracts petiolate, blade broadly to narrowly ovate or elliptic, rounded at base, entire or crenate, acute or obtuse at apex, usually with eglandular hairs all over, more rarely becoming more or less glabrous, cystoliths present on both surfaces, these sometimes obscured by pubescence. *Inflorescence* 1 (-2) flowers per axil in upper leaves, or triad in each axil, outer flowers of triad usually small buds or cleistogamous; flowers more or less sessile. *Bracteoles* shortly petiolate, usually similar in shape and indumentum to leaves and flower subtending bracts but smaller, inserted almost immediately below calyx. *Calyx* with truncate, slightly ridged base, variously pubescent. *Corolla* blue, mauve, purple, lilac or white; tube cylindrical at base, erect, glabrous externally; throat campanulate, bent forward almost horizontally (possibly remaining erect in ssp. *corynotheus*); lobes spreading at right angles to throat, ? with longitudinal folds (palate) on base of each lobe. *Cleistogamous flowers* if present, tiny (3-5 mm long); corolla constricted at base at point of insertion of 4 stamens and often a staminode; stamens with very short (0.5 mm long), glabrous filaments; anthers 2-celled, more or less sagittate by slight prolongation of connective; ovary with stigma sessile or on very short style. *Stamens* of chasmogamous flowers included, inserted at top of tube where it bends into throat, filaments hairy at base where fused to tube, sometimes hairs extending upwards onto free part of filaments and downwards to form a V shaped patch on adaxial side of tube; anthers with connective extended apically or not. *Disc* annular, with irregular rim. *Ovary* glabrous, 5-8 ovules per cell arranged in 2 rows; style usually hairy, sometimes glabrous; stigma included in throat of corolla. *Capsule* glabrous, 1-6 seeds subtended by prominent hooks usually developing near middle of capsule, remnants of undeveloped ovules and hooks usually present. *Seed* appearing glabrous when dry, thickened rim rapidly expanding on wetting to reveal hairs; flattened sides of seeds glabrous. Fig. 8 A-F.

### Typification

Mueller cited two collections when he first described *D. australasicus*, his own from the Dawson and Burdekin Rivers and Gregory's from Coopers River. Unfortunately the Gregory collection has not been located and in its absence it would be preferable not to lectotypify the species. However, since *D. australasicus* is polymorphic and possesses 4 subspecies, of which two are represented by Mueller collections from the Burdekin River, a choice has to be made for nomenclatural reasons. If we compare the characteristics of the Mueller syntypes with the protologue (Table 10) it becomes obvious that the protologue is based on a combination of the characteristics, with the possible exception of the capsule character as only the large-flowered specimens possess capsules. Support for the large-flowered specimen being designated lectotype is given by the fact that the Gregory collection, if found, will undoubtedly be a large-flowered specimen as only these are known from the Coopers River area of the border region of Queensland and South Australia. The Gregory collection could either belong to the same large-flowered taxon as *Mueller MEL 601752*, or possibly to a newly described taxon known only from the Cooper's Creek area (ssp. *glabratus*). If the former is the case this means that the majority of syntypes belong to the widespread central Australian taxon. If the latter is the case the three syntypes known would each belong to a different taxon. However, the only other specimen cited by Mueller (*Stuart MEL 601748*) as *D. australasicus* (Mueller 1865) belongs to the same widespread central Australian taxon as the lectotype. Thus there seems little doubt that the epithet "australasicus" is best applied to the large-flowered taxon of central Australia.



Character	Protologue	Small-flowered MEL 601756/K	Large-flowered MEL 601752/K
leaf length	less than 24 mm	9-14 mm	16-20mm
calyx length	4-8 mm	c. 3 mm	c. 9 mm
bracteole length	6-12 mm	c. 6 mm	10 mm
corolla length	16-30 mm	16 mm	30 mm
capsule length	12 mm	—	12 mm

Table 10: Comparison of diagnostic characters for the two Mueller syntypes of *D. australasicus* with the protologue (Mueller 1859).

Distribution

*D. australasicus* occurs across the northern half of Australia. It is a polymorphic species consisting of four subspecies, one of which is widespread while the other three are more restricted in their range.

Ecology: see subspecies

Notes

1. The reasons for Mueller’s rejection of the name *Dipteracanthus australasicus* are obscure. After the initial publication of the name, based on specimens from the Burdekin River and from central Australia (see Typification), he only applied it to one other specimen collected by Stuart in 1860-2 (Mueller 1865) and then reduced the species to synonymy under the earlier name *Ruellia bracteata* R. Br. (see Note 2). However his own specimens from the Burdekin, which are syntypes of *D. australasicus*, were subsequently included in two groups of specimens which he annotated as *Ruellia australis* R. Br. var. (K sheet) or *Ruellia corynotheca* (MEL sheet) for the small-flowered taxon and *Ruellia australis* var. *primulacea* (K sheet) or *Ruellia primulacea* for the large-flowered taxon, manuscript names which were later published by Bentham (1868) based on these specimens.

Why then did Mueller not use ‘australasicus’ for one of his segregate species? Several explanations are possible. Firstly he did not believe in the priority of epithets, choosing instead to use what he considered to be the more appropriate epithet when circumscriptions changed. Thus *Earlia excelsa* F. Muell. became *Graptophyllum earlii* (this paper) and *Euphrasia brownii* was the new name given by Mueller to a taxon which included a number of previously published species (Barker 1982) as Mueller was of the opinion that “it should be free to those, who effect the reductions to choose a collective designation for the consolidated species” (Mueller 1882).

Secondly, he believed part of his original *D. australasicus* fell within *Ruellia bracteata* R. Br. (See Note 2) and this may have been sufficient for him to reject the epithet. Finally as he had transferred the taxa from *Dipteracanthus* to *Ruellia* and Brown (1810) had already published *Ruellia australis* (= *Brunoniella australis*), he may have thought the epithets to be too close and likely to cause confusion.

2. The reason for Mueller (1867) referring his previously published *D. australasicus* to *Ruellia bracteata* can perhaps be explained if we consider the nature of the information available to him at that time. In 1859, when he first described *D. australasicus*, all that would have been available to Mueller was Brown’s (1810) description of *R. bracteata* and Nees von Esenbeck’s identical (1847a) description of the same taxon, but now placed under *Dipteracanthus* as a “species dubia”. In addition to this was an illustration of *R. bracteata* by

Ferdinand Bauer in Endlicher's (1840) "Iconographia". The description given by Brown is inadequate to distinguish between *R. bracteata* and Mueller's specimens, and at that time he had no specimens of *R. bracteata* available to him.

Bauer's illustration of *R. bracteata* shows a great amount of detail but is unfortunately erroneous in several of these details. The stamens are shown included in the throat instead of exerted, the anthers with acute apices (contrast with Fig. 8H of *D. bracteatus*, this paper) and the stigma as 2-lobed when it should only be 1-lobed. Furthermore, in the opened-out flower the tube and throat are shown as approximately equal in length, but the tube should be longer than the throat. In the flower which is not opened out, the ratio of the tube to throat is correct.

Mueller stated that *D. australasicus* could be distinguished from *R. bracteata* by its "smaller leaves and flowers, a corolla neither glabrous nor forming a long slender tube above the calyx, persistent bracts, blunt deeper-enclosed anthers, and not equal lobes of the stigma". In all of these characters, with the exception of the blunt anthers and the bract character, he was correct in his distinctions between the two species. However, he must have had later doubts about the distinctness of his *D. australasicus* from *R. bracteata* which he described as occurring chiefly from warm eastern Australia to central Australia, but with not all of his specimens corresponding with it.

It is almost certain that Mueller did not see specimens of *R. bracteata* until after 1882, when he received specimens from the collectors Persieh and Powell. These specimens (in MEL) are extensively annotated by Mueller, suggesting that they were the first he had seen.

3. The rank of the four subspecies recognised under *D. australasicus* is arguable. They do not appear to overlap in distribution significantly (with the possible exception of ssp. *australasicus* and ssp. *glabratus*) and the flower size difference between ssp. *corynothecus* and the other three subspecies appears to be maintained within populations. Ssp. *dalyensis* seems to be quite distinct at first glance, but most of these differences relate to habit, size of leaves and crowding of the inflorescence apically, all characters which are influenced by habitat. Similarly the glabrous parts of ssp. *glabratus*, which serve to separate this subspecies from the other three, could also be influenced by habitat. Separation as subspecies rather than species seems to be more appropriate until their relationships with each other can be investigated more fully.

### Key to taxa of *D. australasicus* F. Muell.

- 1a. Corolla less than 2 cm long, throat 4.5-10 mm long. Style 6-7.5 mm long ..... b. ssp. *corynothecus*
- 1b. Corolla more than 2 cm long, throat 11-33 cm long. Style 15-25 mm long ..... 2
- 2a. Corolla throat externally glabrous. Style glabrous. Calyx externally glabrous or sparsely eglandular hairy, internally with glandular hairs. Leaves glabrous except for sparse, fine, curled white eglandular hairs ..... c. ssp. *glabratus*
- 2b. Corolla throat externally hairy. Style hairy or rarely glabrous or almost so. Calyx externally and internally with eglandular hairs all over, often mixed with a few glandular hairs. Leaves scabrous or with some form of eglandular hairs moderately densely all over ..... 3
- 3a. Shrubs, often woody, to 1 m high. Stems with eglandular hairs of various types but the apex narrow-acute and never ending in an elliptic swelling (? gland), mixed with shorter conical eglandular hairs. Leaves more or less entire, largest up to 2.9-4.7 x (1.2) - 1.5-3 cm. Corolla internally with slender hairs forming a V-shaped patch on adaxial side of tube, extending to base of filaments. Flowers either 1 per axil or an axillary triad (the outer 2 flowers often minute buds), more or less equally spaced along the stem ..... a. ssp. *australasicus*
- 3b. Decumbent or sprawling herb to 30 cm. Stems, particularly at upper nodes with fine, lax, 3-8-celled hairs, some ending in an elliptic swelling (? gland), mixed with shorter conical eglandular hairs. Leaves more or less entire, largest up to 2.9-4.7 x (1.2) - 1.5-3 cm. Corolla internally almost glabrous except for very sparse hairs decurrent below the insertion of filaments. Flowers 1-2 in each axil, crowded terminally, not overlapping lower down ..... d. ssp. *dalyensis*

a. ssp. *australasicus*

*Dipteracanthus australasicus* F. Muell., N.S. Wales Votes Proc. Legis. Assembly 2 (1859) 8 p.p. (with respect to large flowered specimens only); F. Muell., Appendix Journals J. McD. Stuart (1865) 502.

*Ruellia primulacea* F. Muell. ex Benth., Fl. Austral. 4 (1868) 546; F. Muell., Syst. Census Austral. Pl. (1882) 99; F. Muell., Sec. Syst. Census Austral. Pl. (1889) 168; F.M. Bailey, Qld Fl. 4 (1901) 1104; F.M. Bailey, Compr. Cat. Qld Pl. (1913) 374, f. 348; Ewart & Davies, Fl. N. Terr. (1917) 251; J.S. Beard, W. Austral. Pl. (1965) 119; J. Green, Census Vasc. Pl. W. Austral. (1981) 95.

*Lectotype here designated:* Anon. (? Mueller) s.n., s. dat., Burdekin River (MEL-601752, K). *Other syntypes:* Anon. (McDouall Stuart) s.n., s. dat., Barcoo (MEL-601753); Bowman s.n., s. dat., Elliot River (MEL-601749); Bowman 83 & 87, s. dat., Sellheim River (MEL, K); Bowman 329, s. dat., Elliot River (MEL). *Possible syntype:* McDouall Stuart s.n., c. 1860, Central Australia (MEL-601748).

*D. sessiliflorus* Bremek., Acta Bot. Neerl. 11 (1962) 196; Chippendale, Proc. Linn. Soc. N.S. Wales 96 (1971) 259. *Holotype:* Chippendale s.n., 26.iii.1958, White Range, 4 m NE of Arltunga Mission (NT 4103). *Isotypes:* (AD, BRI, MEL). *Syntypes:* Chippendale s.n., 9.vii.1957, Harts Range, 6 m S of Police Stn (NT 3487, CANB, NSW).

*D. corynothecus* (F. Muell. ex Benth.) Bremek. ex W.R. Barker, Fl. Central Austral. (1981) 336.

"*Justicia kempeana* var." F. Muell., Fragm. Phyt. Austral. 11 (1880) 101, p.p. (as to Giles MEL-601998, MEL-601999).

*D. corynothecus* var. *grandiflorus* Bremek., Acta Bot. Neerl. 11 (1962) 197, nom. invalid; Chippendale, Proc. Linn. Soc. N.S. Wales 96 (1962) 259.

*D. primulaceus* (F. Muell. ex Benth.) Bremek., Acta Bot. Neerl. 11 (1962) 197, nom. invalid.

*Ruellia bracteata* auct. non R. Br.; F. Muell, Fragm. Phyt. Austral. 6 (1867) 91, p.p. (as to large-flowered specimens placed under *D. australasicus*).

*D. corynothecus* (F. Muell. ex Benth.) Bremek. var. *corynothecus*, nom. invalid., auct. non Bremek.: Chippendale, Proc. Soc. N.S. Wales 96 (1971) 259.

Compact, intricately branched, woody shrub 30-150 cm tall, main branches spreading, minor branches erect or, more rarely, scandent over bushes to 2 m high. *Leaves* and flower subtending bracts with petioles 2-6 (-12) mm long; blade ovate or oblong, 8.5-25 (-38) x (2.5-) 5-11.5 (-20) mm, scabrous or with short, white, appressed hairs, particularly dense in young parts. *Inflorescence* a single flower per axil or triad with outer flowers present as tiny buds, presumably often cleistogamous. *Pedicel* 0-6 mm long. *Bracteole* with petiole 2-7 mm long, blade 6-16 x 1.2-7 mm, shape and indumentum similar to leaves. *Calyx* 5.5-13.5 mm long, lobes joined for 1/4 - 1/5 of length, moderately dense eglandular hairs mixed with occasional glandular hairs. *Corolla* blue, mauve or purple; tube (3-) 4-9 mm long, internally with V-shaped patch of hairs at apex of tube; throat (11-) -17-26-(33) mm long externally with fine hairs, internally glabrous; lobes 6-16 (-20) mm long, ? with reddish lines. *Style* eglandular, hairy, sometimes sparsely so, 16-22 mm long. *Capsule* (7.5-) 10-17 (-20) mm long, with 3-5 seeds developing in each valve. *Seed* 4-4.5 mm diameter. Fig. 8 A-D.

### Typification

#### 1. *Ruellia primulacea* F. Muell. ex Benth.

Of all the specimens cited by Bentham (1868), the only collection which has capsules and seed is the Mueller collection from Burdekin River. The other syntypes consist only of branches with 1-2 large flowers, and so the best material has been designated as lectotype. The McDouall Stuart collection from Central Australia, although seen by Bentham, is not cited in the protologue.

## 2. "*Dipteracanthus corynothecus* var. *grandiflorus*"

In recognizing the new combination of "*Dipteracanthus corynothecus*" Bremekamp (1962) failed to cite the basionym and so this name is invalid, and (Art. 43, ICBN) the name of the new variety he ascribed to it, var. *grandiflorus*, is also invalidly published.

### Distribution

Ssp. *australasicus* is found in two widely separated areas, one spread from around Alice Springs (Central Australia in the strict sense) into northern South Australia, north-west New South Wales and south-west Queensland, the other in north-west Western Australia between Carnarvon and the Hamersley Ranges. Fig. 9.

### Ecology

This subspecies is most commonly found in rocky areas near or in creek beds. There are two references to woodland on herbarium labels, one collection being from within dense mulga (*Acacia aneura*), another being found in association with *Acacia melleodora*, *Cassia artemisioides* and *Eucalyptus papuana*. Flowering has been recorded in most months of the year and is presumably dependent on rains.

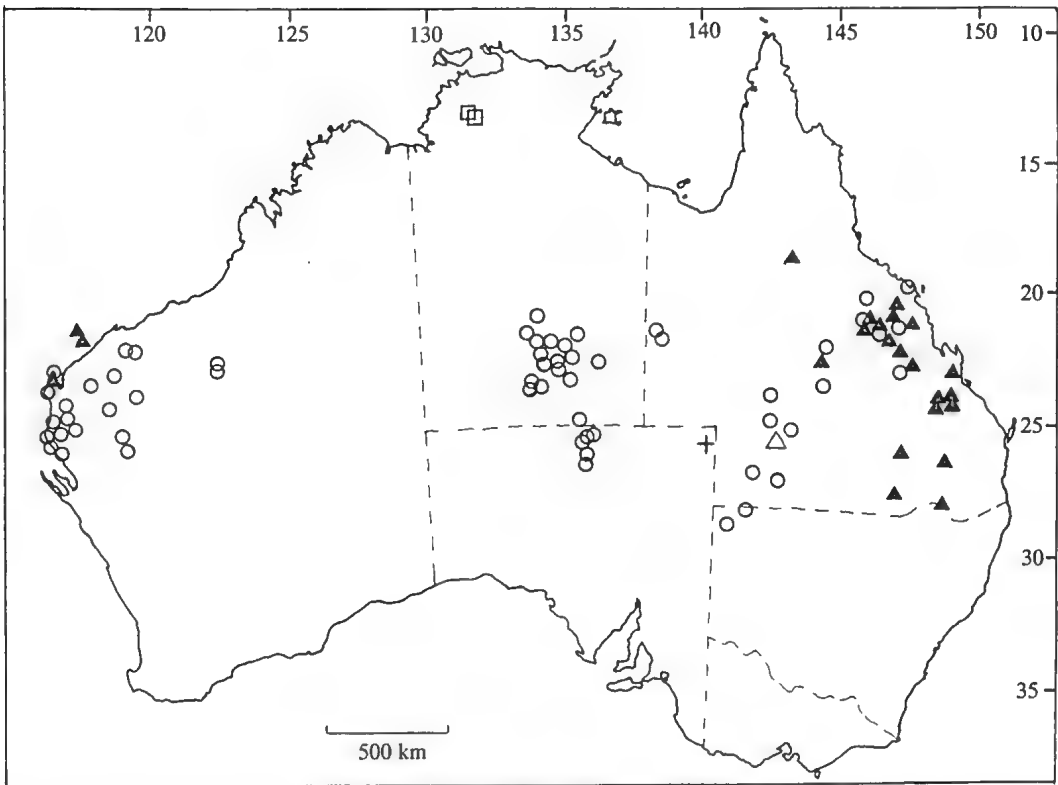


Fig. 9. Distribution of the subspecies of *Dipteracanthus australasicus*. (○ ssp. *australasicus*; ▲ ssp. *corynothecus*; △ specimen having characteristics of ssp. *australasicus* and ssp. *corynothecus*; + ssp. *glabratus*; □ ssp. *dalyensis*).

## Notes

1 Within this taxon there are a number of Western Australian specimens, particularly from the Minilya River area, with corolla throats that are larger than the more normal range of 17-27 mm long. In these specimens there appears to be no correlation with any other character, nor is there any pattern to their distribution; they are therefore at this stage given no formal taxonomic status. Corolla throats in specimens including isotype material identified by Bremekamp as *D. corynothecus* var. *grandiflorus* are smaller than in these Western Australian specimens; they fall within the normal range given above.

2. The Stanley & Ross collection from the South Kennedy district of Queensland has large flowers but, unlike the above case, it is the lobes which are longer than usual (c. 20 mm compared with 6-16 mm). In addition the plant is recorded as prostrate, but the more usual habit is that of a woody erect shrub, although there are records (*Latz 138*) of it becoming a climber if support is available. Further collections from this area are required to establish whether a separate taxon is present.

3. Western Australian specimens of ssp. *australasicus* differ from specimens from the eastern part of the species range by their tendency to have larger, narrowly ovate to oblong leaves with more or less entire margins. In contrast the Central Australian material usually has smaller ovate leaves with distinctly undulate or toothed margins. However, within Queensland the leaves tend to become larger, more dense and more or less entire, thus approaching the Western Australian specimens.

## Representative specimens examined (c. 119 specimens seen)

NEW SOUTH WALES: *Anon.* (? *Bäuerlen*) 296, xi.1887., Mt Poole (MEL 100743, NSW 143886); *Stanley 1764*, 8.x.1975, Olive Downs (NSW).

NORTHERN TERRITORY: *W.R. Barker 2809*, 15.viii.1978, western perimeter of Aileron township, ½ km W of hotel, ridge S of race course (AD); *Beauglehole 20655*, 13.x.1966, Ross River, nr Giant Ghost Gums, 30 m ENE of Alice Springs (NT); *Byrnes 565*, 7.iii.1968, 15 m E Alice Springs, Undoolya Rd (DNA, NT, AD); *Latz 138*, 9.ii.1968, 57 km NE Alice Springs, Mt Riddock Rd (NT, AD, MEL); *Lazarides 6098*, s. dat. 7 m W of Aileron Township (MEL, BRI, CANB — 2 sheets, NSW, AD, NT); *Maconochie 470*, 8.ix.1967, Stud Bore, 1 m W of Bore, Todd R. Stn (MEL, AD, NT); *McDouall Stuart s.n.*, 1860-2, ? between the Finke River and MacDonnell Range (MEL 601748); *Perry 3378*, 10.iii.1953, 6 m NE of Yambah Station (BRI, K, NT, CANB — 2 sheets, NSW, BRI); *Symon 34*, 30.v.1953, 6 m before Gillen Ck on road to Harts Range (N side) and about 10 m before "Mud Tank" (ADW); *Willis s.n.*, 28.v.1974, Harts Range, Mt Brassey foothills (near mica mines on N slopes) (NT, MEL).

QUEENSLAND: *Anon* (*Mueller*) *s.n.*, s. dat. Burdekin River (MEL 601752: lectotype of *D. australasicus* and *R. primulacea*); *W.R. Barker 2684*, 5.viii.1978, Gidya Creek crossing by main Windorah-Bedourie road, c. 37 km by road W of Currawilla H.S. (AD); *Coghlan s.n.*, 27.xii.1892, Glenormiston, Boulia (BRI); *Purdie 1065*, 12.ix.1977, Creek, 15 km WSW of Linda Downs (BRI); *Smith 6082*, 15.xi.1954, Whynot Stn, c. 38 km WSW of Quilpie (BRI); *Simmonds 367*, 1889, Thargomindah (BRI); *Stanley 78399 & Ross*, 20.xi.1978, c. 20 km from Gregory Hwy turnoff along Bowen Development Road (BRI)

SOUTH AUSTRALIA: *Houston 4*, 24.iv.1977, 45 km ENE of Dalhousie Homestead ruins (AD); *Lothian 4822*, 27.vii.1968, foothills of Emery Ranges, c. 22 km E of Pedirka (AD); *Reid* (*Pastoral Board of S.A.*), 13.x.1955, Allandale Stn near Oodnadatta (AD 96312114, AD 97913187, AD 97630134); *Symon 9129*, 19.ix.1974, more or less 6.5 km WNW of Mt Alexander (ADW).

WESTERN AUSTRALIA: *Blockley 24*, 14.ix.1965, 17 m from Duck Ck Junction, near Mt Farquar in Ironstone Gorge (KINGS PARK); *Gardner 3213*, 29.viii.1932, Barabiddy Ck, Minilya River (PERTH, BRI); *George 3541*, 4.iii.1962, more or less 1 m E of Millstream Homestead (PERTH); *Hutchinson 172*, 31.viii.1977, Ningaloo Station, Exmouth (PERTH); *Setter 419*, 12.x.1973, c. 4 m NNW of Woolgatharra Pool, Mt Augustus Stn, via Meekatharra (PERTH).

b. ssp. *corynothecus* (F. Muell. ex Benth.) R.M. Barker, comb. et stat. nov.

*Ruellia corynotheca* F. Muell. ex Benth., Fl. Austral. 4 (1868) 546: BASIONYM; F. Muell., Syst. Census Austral. Pl. (1882) 99; F. Muell., Sec. Syst. Census Austral. Pl. (1889) 168;

F.M. Bailey, Qld Fl. 4 (1901) 1145; F.M. Bailey, Compr. Cat. Qld Pl. (1913) 374, f. 348b; Maiden & Betche, Census N.S. Wales Pl. (1916) 185. — *D. corynothecus* (F. Muell. ex Benth.) Bremek., Acta Bot. Neerl. 11 (1962) 195 p.p. (as to published text only, not to specimens: see Note 2), nom. invalid: Jacobs & Pickard, Pl. N.S. Wales (1981) 61.

*Lectotype here designated: Anon. (Dorsay or Bowman) ?401*, s. dat., Suttors River (MEL 601758). *Syntype and probable islectotype: (MEL 601754). Syntypes: Anon. (Mueller) s.n.*, s. dat. Burdekin River (MEL 601756); *Dorsay s.n.*, s. dat., Suttor (MEL 60175, K). *Probable syntypes: Bowman 265*, s. dat., ? (Bo)wen River (MEL 601757); *Anon. 24*, s. dat., Fort Cooper (MEL 602019); *Anon. s.n.*, s. dat. (MEL 602016).

*D. australasicus* F. Muell., N.S. Wales, Votes Proc. Legis. Assembly 2 (1859) 8 p.p. (as to *Mueller MEL 601756*).

Low woody subshrub, 10-25 cm high, branches decumbent, dense and forming clumps to 30 cm diameter. *Leaves* and flower subtending bracts with petioles 1-8 mm long; blade narrowly to broadly ovate, 8-17.5 x 6-11.5 mm, more or less glabrous to scabrous, or (Western Australia) with dense, short, appressed, white tomentum. *Inflorescence* a single flower in each axil of upper leaves. *Pedicel* 0-2 mm long. *Bracteoles* with petioles 1.5-3 mm long; blade 7-10 x 2.2-3.6 mm, with similar indumentum to leaves, sometimes also with sparse glandular hairs. *Calyx* 4.7-7 mm long, joined for c. 1/3 of length, eglandular hairs particularly on margins of lobes, sometimes with sparse glandular hairs mainly on inner surface of lobes. *Corolla* white, pale blue or mauve; tube 1.8-4 mm long, externally and internally glabrous; throat 4.5-10 mm long, externally with fine eglandular hairs, internally with line of hairs on abaxial surface, glabrous elsewhere; lobes 3-6 mm long. *Style* sparsely eglandular hairy, 6-7.5 mm long. *Capsule* 7.5-13 mm long, with 1-6 seeds on well-developed hooks. *Seed* 3.5-4.5 mm diameter. Fig. 8E.

### Typification

There are 7 sheets in MEL which bear the annotation "Ruellia corynotheca Ferd. Mueller" which have also been seen by Bentham. Of these, the specimens *MEL 602019*, *MEL 602016* and *Bowman 265* are not cited in the protologue.

### Distribution

*Ssp. corynothecus* is found in south-eastern Queensland, extending south from the Mackay area to the New South Wales/Queensland border. In addition there are two similar specimens from islands off the coast of Western Australia. The minor differences between these widely disjunct populations are discussed in Note 1. Fig. 9.

### Ecology

In Queensland this subspecies has most commonly been collected from brigalow (*Acacia harpophylla*) communities, frequently on clay soils and either from scrub or from areas regenerating after clearing. Other records are of growth "in red soil with *Acacia aneura* and *Eremophila bowmannii*" (*Skerman BRI 011607*) and from under *Heterodendrum* on a sandy creek bank. Several annotations indicate that the plants are "readily" or "with relish" eaten by sheep, cattle and horses. The Western Australian collections have no ecological annotations. As with *ssp. australasicus*, flowering is probably dependent on rains as there appear to be flowering specimens from throughout the year.

### Notes

1. Despite the extreme disjunction of the populations of this subspecies, they seem to differ only in the indumentum of the leaves, bracts and bracteoles. The Western Australian

specimens tend to have a short appressed white tomentum while the Queensland specimens vary from more or less glabrous to scabrous. Further collections from Western Australia may reveal other differences.

2. Bremekamp's concept of *D. corynothecus* appears confusing. In his transfer of *R. corynotheca* F. Muell. ex Benth. to *Dipteracanthus* (Bremekamp 1962), he seems to have been well aware of the difference in size of the flowers of *D. corynothecus* and *D. primulacea* as he described his new variety of *D. corynothecus* as having "a corolla of the same size as that of *D. primulacea*, which means that it is much larger than that of the typical form of *D. corynothecus*". Why he should then have annotated specimens (in NT and AD) of the large-flowered Central Australian taxon as *Dipteracanthus corynothecus* is not known, but it caused subsequent confusion in treatments of the Central Australian flora (Chippendale 1971, W.R. Barker 1981).

### *Specimens examined*

NEW SOUTH WALES: *Mulham W950*, i.1977, Onepah (NSW).

QUEENSLAND: *Adams 1057*, 13.vii.1964, 1.5 m ENE of 'Avon Downs' Stn (BRI, K, CANB); *Anderson 2061*, 24.vi.1980, 'Barwon Park', c. 70 km N of Blackwater (BRI); *Anon. (Mueller) s.n.*, s. dat. Burdekin R (MEL 601756); *Anon. s.n.*, s. dat., Suttor (MEL 601754); *Anon. 401?*, s. dat., Suttors River (MEL 601758: Lectotype of *R. corynotheca*); *Anon. (? Bowman) 24*, s. dat., Fort Cooper [= Nebo] (MEL602019); *Anon. 216*, s. dat., Roma (MEL 100742); *Anon. s.n.*, s. dat., (MEL 602016); *Bowman 265*, s.n., ? (Bo)-wen River (MEL 601757); *Blake 19985*, 17.v.1956, S of Biloela (BRI); *Burkitt s.n.*, s. dat., Peak Downs (MEL 602017); *Cooney s.n.*, x.1935, 87 Mile, via Barcardine (BRI); *Crisp 2857*, 6.vi.1977, 5.6 km from Theodore along rd to Taroom (CBG, BRI); *Davidson 316*, i.1953, 16 m NW of Longreach (BRIU, BRI); *Dorsay s.n.*, s. dat., Suttor (MEL 601755); *Hando 17*, 15.x.1978, Chinchilla Rifle Range (BRI); *Henderson 224*, 1.iii.1967, c. 4 m E of Moura (BRI); *Johnson s.n.*, 1894, Upper Gilbert R (MEL 564025); *Jones 3722*, iii.1968, Moura (CANB); *O'Shanesy 1055*, 1.ii.1869, Gracemere (near Rockhampton) (MEL); *O'Shanesy 3060*, 1879, (? Comehills) (MEL); *Saclier 16*, 28.x.1957, Logan Downs Pty. Ltd., Wentworth, 68 m N of Clermont (BRI); *Skerman s.n.*, 4.vi.1958, Thylungra (BRI 011607); *Smith 3477*, 23.x.1947, Experimental Farm, Biloela (BRI, K, CANB — 2 sheets); *Verdon s.n.*, 2.xii.1977, Canberra Botanic Gdns cuttings from *Crisp 2857* (CBG); *Wedd 628*, v.1894, St George (BRI); *White 10401*, 24.iv.1936, Bybera (BRI).

WESTERN AUSTRALIA: *Dix s.n.*, 13.xi.1953, Alpha and Monto Bello Islands (CANB); *George 2947*, 2.vi.1961, Cape Range, rd to No. 4 Well (PERTH).

### Specimens with affinities to ssp. *corynothecus*

QUEENSLAND: *Skerman s.n.*, 4.vi.1958, Thylungra (BRI 011607).

WESTERN AUSTRALIA: *Butler s.n.*, vi.1964, Barrow Island (PERTH).

### c. ssp. *glabratus* R.M. Barker, ssp. nov.

?*D. australasicus* F. Muell., N.S. Wales Votes Proc. Legis. Assembly 2 (1859) 8 p.p. (as to Gregory collection, n.v.).

Subspecies nova *D. australasici*, differt a ssp. *corynotheco* floribus grandioribus et a subspeciebus omnibus alteribus fauco corollae externo glabro, stylo glabro et foliis et calycibus plus minusve glabris.

*Holotype*: W.R. Barker 4627, 15.ix.1984, 24.8 km NW of Cordillo Downs and c. 6 km past Bulls Hole Creek on road to Cadelga (AD). *Isotypes*: to be distributed.

Perennial, more or less glabrous woody shrub to 80 cm tall, ? main branches spreading, minor branches erect. *Leaves* and flower subtending bracts with petioles 1.5-3 mm long, blade ovate to oblong, 8.5-16.5 x 4.5-11 mm, more or less glabrous, or a few short, white, recurved hairs on nodes, petioles and margins of leaves. *Inflorescence* either a single flower per axil or triad appearing as a single flower with (? cleistogamous) buds either side. *Pedicel* (or peduncle in triads) 3.5-6 mm long. Bracteoles with petiole 1-4 mm long; blade 6.8-11.5 x 3.7 mm, similar indumentum to leaves. *Calyx* 8.5-10.5 x 0.9-1.3 mm, joined for c. 1/3 of length, more



or less glabrous except for short glandular hairs particularly internally, sometimes also externally. *Corolla* blue; tube 7.5-8 mm long, internally with V-shaped patch of hairs on adaxial side of ridges decurrent from insertion of stamens, otherwise glabrous; throat 15.5-29 mm long, glabrous externally, internally glabrous or adaxially with single row of hairs; lobes 9-14 mm long. *Style* 16.5-25 mm long, glabrous. *Capsule* 9-14.5 mm long, with 6-8 seeds in 2 rows in each valve, only 1-5 fully developed. *Seed* c. 4 mm diameter.

### Distribution

Ssp. *glabratus* is known only from the Cordillo Downs area in the far north-east of South Australia and from an unspecified locality on Cooper's Creek. Fig. 9.

### Ecology

Records are confined to the collections *Lothian & Francis 651*, from an *Acacia* lined creek or from the gibber plain adjacent to it, and *Milthorpe & Cunningham 3127* from skeletal soil. The collections all have flowers and were made from August to October.

### Notes

1. The subspecies is easily distinguished from the three other subspecies of *D. australasicus* by its glabrous corolla throat, style and calyx, characters previously recognized by W.R. Barker from his annotations on *Lothian 651* and *Lewis AD 97646417*. The *Milthorpe & Cunningham* collection was also recognized as distinct; it was annotated (? by the collectors) as "sp. nov., near *D. corynothecus* but quite distinct", although without a diagnostic statement.

2. The single flower opened on the *Lothian* collection has a staminode as well as the 4 stamens, and the Lewis and Barker specimens have a line of hairs on the adaxial surface of the throat. More material is needed to establish the limits of morphological variation in this subspecies.

3. As this subspecies has been collected from Cooper's Creek there must be a possibility that the unlocated Gregory collection (see *D. australasicus*: Typification) from Cooper's River is *D. australasicus* ssp. *glabratus* and not ssp. *australasicus* as already proposed.

### Specimens examined

SOUTH AUSTRALIA: *W.R. Barker 4627*, 15.ix.1984, 24.8 km NW of Cordillo Downs and c. 6 km past Bulls Hole Creek on road to Cadelga (AD); *W.R. Barker 4633*, 15.ix.1984, 10 km N of Koonabera Creek and 2 km S of Cadelga Creek on road between Cordillo Downs and Cadelga (AD); *Lewis s.n.*, 30.x.1976, Cordillo Downs (AD 97646417); *Lothian & Francis 651*, 29.viii.1960, Cordillo Downs campsite, 5 m WNW of Cordillo Downs Homestead (AD); *MacGillivray 468*, viii.1920, Coopers Creek (ADW); *Milthorpe & Cunningham 3127*, x.1973, Cordillo Downs (NSW).

### d. ssp. *dalyensis* R.M. Barker, ssp. nov.

Subspecies nova *D. australasici*, differt a ssp. *corynotheco* floribus grandioribus, a ssp. *glabrato* foliis scabris, stylo pubescenti et fauce corollae externo hirsuto, a ssp. *australasico* foliis grandioribus, inflorescentiis aggregatis terminalis, habitu herbaceo et tubo corollae interno glabro.

*Holotype*: *Byrnes 1241*, 19.xii.1968, 15 m W of Highway, Daly River Rd (DNA). *Isotypes*: (DNA; NT).

Decumbent herb to 30 cm high, branches covered by short, conical eglandular hairs, sometimes with fine lax 3-8-celled hairs ending in elliptic swelling (? gland). *Leaves* and flower

subtending bracts with petioles 5-8 mm long, blade broadly ovate, (20)-29-47 x (12)-15-30 mm, scabrous, particularly on veins and margin. *Inflorescence* of 1-2 flowers per axil, sometimes present only as possibly cleistogamous buds, well-spaced lower down, crowded terminally. *Pedice*l (or peduncle in paired flowers) 2.5-6 mm. *Bracteole* with petiole 2-3 mm long; blade 12.5-21 x 4-7 mm, with similar indumentum to leaves and bracts. *Calyx* c. 5.5-6 mm long, joined for c. 0.5 mm, eglandular hairs particularly on margin and midrib of lobes. *Corolla* mauve; tube 9 mm long, internally and externally glabrous, apart from a few sparse hairs continuing below insertion of stamens; throat 16.5-20 mm long, externally with fine hairs, particularly on veins, internally glabrous; lobes 9-11 mm long. *Style* eglandular hairy, 15-17 mm long. *Capsule* c. 13.5 mm long, ? 2-4-seeded. *Seed* 6 x 4 mm. Fig. 8F.

### *Distribution*

*Ssp. dalyensis* is known from only five collections from between Daly River and the Stuart Highway in the Northern Territory. Fig. 9.

### *Ecology*

The subspecies has been twice recorded from open *Eucalyptus* woodland, with the collections *Byrnes* 1241 and 1276 coming from red loam. The collection *R.M. Barker* 358 was found in remnant vegetation in an agricultural area overrun by horehound (*Hyptis*). The showy flowers are produced in December-January, while *Barker* 358 collected at the end of April, bears one tiny and possibly cleistogamous flower as well as a mature capsule.

### *Note*

The number of specimens is inadequate to gauge the variability of this subspecies. While the *Byrnes* collections appear very distinct from *ssp. australasicus* the two collections made by me approach more closely to *ssp. australasicus*.

### *Specimens examined*

NORTHERN TERRITORY: *R.M. Barker* 356, 29.iv.1983, Road into Douglas Daly Research Farm (AD); *R.M. Barker* 358, 29.iv.1983, Middle Creek, on road to Douglas Daly Research Farm (AD); *Byrnes* 28, 13.xii.1966, 3 m E of Douglas Experimental site (DNA, NT); *Byrnes* 1241, 19.xii.1968, 15 m W Hwy, Daly R. Rd (DNA — 2 sheets, NT); *Byrnes* 1276, 10.i.1969, Foster Block, Daly R. Road (NT, DNA).

2. *Dipteracanthus bracteatus* (R.Br.) Nees in A. DC., Prodr. 11: (1847) 143. — *Ruellia bracteata* R. Br., Prodr. (1810) 479; Endl., Icon. Gen. Pl., f. 104; Benth., Fl. Austral. 4 (1868) 546; F. Muell., Fragm. Phyt. Austral. 6 (1867) 91; F. Muell., Syst. Census Austral. Pl. (1882) 99; F. Muell., Sec. Syst. Census Austral. Pl. (1889) 168; F.M. Bailey, Qld Fl. 4 (1901) 1144; F.M. Bailey, Compr. Cat. Qld Pl. (1913) 374; S. Moore, J. Bot. 58 (1920) 79 (New Guinea occurrence); Domin, Biblioth. Bot. 89 (1929) 603.

*Lectotype here designated*: *R. Brown* s.n., 6.ii.1803. Arnhem Bay, Point U1 (= Mt Caledon), Arnhem N: Bay (Melville Bay), Islands y1, y2 and z (Cotton, Pibassoo and Inglis Islands) (BM). *Isolectotypes*: BM, K: 2 sheets.

*Dipteracanthus australasicus* auct. non F. Muell.: F. Muell., Fragm. Phyt. Austral. 6 (1867) 91; Domin, Biblioth. Bot. 89 (1929) 603, *pro syn.*

Herb, 15-30 cm tall, with long, somewhat thickened roots. *Branches* more or less square in cross-section, grooved along face with dense, linear cystoliths parallel to main axis, scabrous in young parts, less densely so in older parts. *Leaves* and flower subtending bracts with short (5-7 mm long), broad petiole; blade ovate, 3.8-7.5 x 1.2-4 cm, obtuse at base, entire, apically

acute or obtuse, dark green above, paler below, scabrous particularly on midrib, veins and margin of lower surface, usually all over upper surface. *Inflorescence* a single long pedicellate flower in each upper axil, forming a terminal raceme; *cleistogamous flowers* probably present (Note 2). *Pedice* (axil to bracteole base) 3-60 mm long, moderately densely to densely eglandular hairy. *Bracteoles* inserted almost immediately below calyx, leaf-like, sessile or very shortly petiolate, ovate, 1.7-2.6 x 1-1.1 cm, enclosing base of flower and usually more or less whole capsule. *Calyx* 7-8.5 mm long, truncate at base by a transverse ridge, with cystoliths all over externally, fine eglandular hairs internally and on margins. *Corolla* white or cream, opening at night, deciduous in morning; tube 20-26 mm long, narrow, glabrous externally and internally; throat 9.5-17 mm long, hairy externally, glabrous internally, ? with palate. *Stamens* exserted, inserted at top of tube; filaments glabrous, longer abaxial pair c. 10 mm long, shorter adaxial c. 8 mm long; anthers ? white, apex of connective truncate or slightly forked, ? not extended past anther cells or only slightly so. *Disc* annular with irregular rim. *Ovary* with sparse glandular hairs in apical half, otherwise glabrous, 2 rows of 4 superposed ovules per cell; style hairy, c. 3-3.5 cm long; stigma exceeding throat and stamens, exserted from throat. *Capsule* 17-18.5 mm long, very sparsely eglandular hairy, 5-6 seeds per valve, each with well-developed hooks at base; depauperate capsules sometimes present (Note 2). *Seed* c. 3.5 mm diameter, rim with dense mucous hairs which expand rapidly on wetting, flattened side of seed with shorter, ? non-mucous eglandular hairs. Fig. 8 G-H.

### Distribution

In Australia *D. bracteatus* is known only from Cape York Peninsula, adjacent Torres Strait islands and Arnhem Land in the Northern Territory. It is only known by three collections from Arnhem Land, but from field experience there it is probably not as rare as the collections indicate. The species is also found in New Guinea. Fig. 10.

### Ecology

*D. bracteatus* has been recorded from grassy areas and rocky slopes within *Eucalyptus* forest or woodland (*E. tetradonta*), the soils being recorded as granitic, lateritic and red loam. Flowering specimens have been collected between October and April.

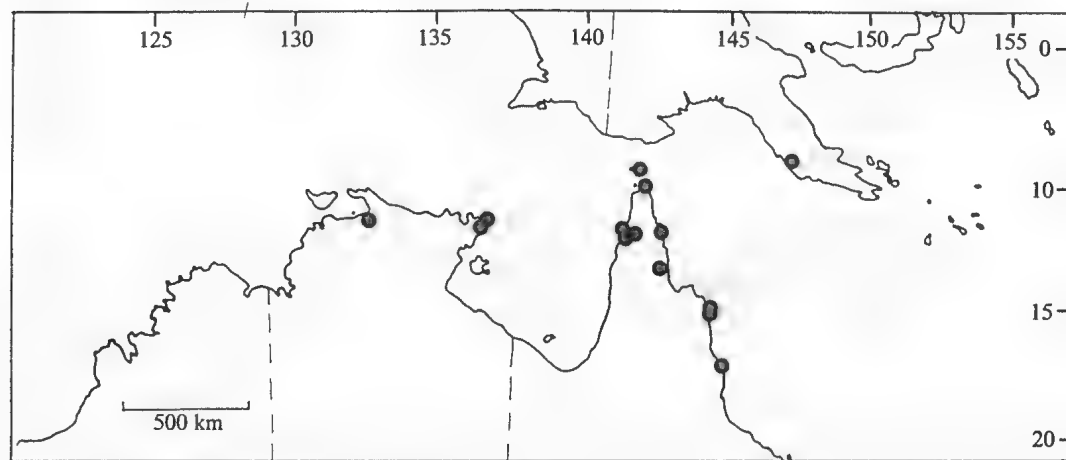


Fig. 10. Distribution of *Dipteracanthus bracteatus*.

## Notes

1. The flowers open at night, dropping off in the morning, and they possess an extremely long tube with exerted stamens and stigma; it is likely that the flowers are moth-pollinated.

2. Cleistogamous flowers possibly occur in this species as shown by the presence of a number of shorter styles (c. 1 cm long) on the specimens. Depauperate capsules on some of the specimens (*Specht & Salt W13*, *Flecker 11966*) may be the products of cleistogamy. They are usually fewer-seeded than the normal capsules.

*Specimens examined*

NORTHERN TERRITORY: *R.M. Barker 445*, 6.v.1983, Arnhem Highway, 31 km E of S. Alligator River (AD); *Brown 2942*, ii.1803, Caledon Bay, Mt Caledon, Cotton, Pibasoo's and Inglis Islands. Melville Bay (BM: lecto and isoelectotype, K: 2 sheets); *Dunlop 6671*, 1984, Gove (DNA).

QUEENSLAND: *Baker (N.Q. Nat. Club 8722)*, iii.1944, Jacky Jacky, Cape York Penins. (BRI); *Blake 20228*, 30.i.1958, Cooktown (BRI); *Clarkson 3807*, 16.x.1981, Thursday Island (AD); *Flecker 8623*, 12.iv.1944, Portland Roads (QRS); *Flecker 11966*, 25.xii.1947, Thursday Island (QRS, BRI); *Garraway s.n.*, s. dat., Coen (BRI 144326); *Hyland 9244*, 5.xii.1976, Walsh River (AD); *Macgillivray s.n.*, 17.xi.1849, Cape York (K); *Morton 1036*, 4.i.1981, Andoom-Fire Study Block — beyond Andoom Ck, 12.5 km N of Lorim Pt, Weipa (BRI); *Persietz 308*, 1882, Endeavour R (MEL); *Powell s.n.*, 1882, Goode Island (MEL 100852); *Powell 7*, s. dat. Goode Island (MEL); *Scarth-Johnson 858A*, 23.x.1979, York Stn (BRI); *Specht & Salt W13*, 9.xii.1974, 5 km ENE of Weipa Mission (BRI).

PAPUA NEW GUINEA: *Gillison NGF 22035*, 11.xii.1964, Moitaka, Central District, Papua (LAE).

8. **BRUNONIELLA** Bremek.

Three of the previously recognized species included under *Brunoniella* here, *B. australis*, *B. acaulis* and *B. pumilio*, were first described by Robert Brown (1810) under *Ruellia*. Nees von Esenbeck (1847a) transferred *R. australis* R. Br. to his genus *Cryphiacanthus* which consisted of 7 American species and questionably referred *R. acaulis* there, while *R. pumilio* was transferred to his genus *Dipteracanthus*.

Bentham (1868) described a fourth species, *R. spiciflora*, based on a manuscript name of Mueller's. He also considered *R. pumilio* to be a variety, var. *pumila*, of *R. australis*, retained *R. acaulis*, and referred all three species to *Ruellia* Sect. *Cryphiacanthus*. Lindau (1895) assigned three of these Australian taxa to species in *Ruellia* Sect. *Ruellia*, but the fourth, *R. pumilio*, was placed under Sect. *Dipteracanthus*. It should be noted that Nees's *Cryphiacanthus* cannot be taken up because the type species, *C. barbadensis*, is a synonym of *Ruellia tuberosa* L., the type of the earlier described genus *Ruellia*.

Clarke (1907) created a new genus *Aporuellia*, distinct from *Ruellia* by its pollen with "minute prickles or papillae, or granulated; not honeycombed". Within this genus he described two new species, *A. axillaris* from the Malay Peninsula and *A. sumatrensis* from Sumatra, as well as listing six other *Ruellia* species, including the Australian *R. acaulis*, *R. australis* and *R. spiciflora*, which he considered might be referable to it. He did not mention *R. pumilio* in this list.

In investigating the two Malesian *Aporuellia* species, Bremekamp & Nannenga-Bremekamp (1948) found that *A. axillaris* possessed the 'prickly' pollen of the original diagnosis, but that *A. sumatrensis* did not. On this basis they chose *A. axillaris* as the type of the genus *Aporuellia*. However, they also showed that *A. axillaris* belonged to the earlier described *Dipteracanthus*, thus making *Aporuellia* a superfluous name. *A. sumatrensis* was referred to a new genus *Pararuellia*, while Bremekamp (1964) later transferred the Australian species previously referred to *Aporuellia* by Clarke to a new genus, *Brunoniella*.

Hossain (1973) was of the opinion that the *Ruellia* species which Clarke (1907) listed as referable to *Aporuellia* without formal combinations having been made, could have been

taken into account by Bremekamp when choosing the lectotype of the genus. This would then have meant that if a different lectotype from *A. axillaris* was designated, *Aporuellia* could have been retained as a generic name for any of the six *Ruellia* species in which the pollen was found to possess “minute prickles”. As Bremekamp (1964) in his generic description of *Brunoniella* describes the pollen as “minutissime tuberculata”, a lectotypification based on an Australian species would entail the use of the generic name *Aporuellia* rather than *Brunoniella*. If we refer to Clarke’s protologue, even though he did not formally make the combinations for the *Ruellia* species he listed, (Art. 33, ICBN), this does not preclude their consideration for choice of a lectotype. Therefore, Hossain seems correct in his opinion that Bremekamp could have chosen another lectotype. However, Bremekamp’s choice of one of the two species fully described under *Aporuellia* by Clarke seems justified, particularly as according to Bremekamp it conforms with the protologue in possessing minutely tuberculate pollen. To change his choice of lectotype it would need to be shown that Clarke placed more weight on another species, or group of species, than the present lectotype in his establishment of the genus, or that *Aporuellia axillaris* Clarke does not possess minutely tuberculate pollen. Although both of these premises seem unlikely, an examination of Clarke’s material at Kew would seem advisable.

The generic concepts followed here are those of Bremekamp (1964). On this basis the Australian species included under *Brunoniella* differ from *Pararuellia* by their axillary as opposed to terminal inflorescences and their sparsiporous pollen as opposed to pollen with three equatorial pores in *Pararuellia*. According to Bremekamp (1964) *Brunoniella* agrees with *Dipteracanthus* in its pollen morphology although my own preliminary investigation of this showed Australian *Dipteracanthus* species to have reticulate pollen while the *Brunoniella* species were “prickly”. The two genera also differ in bracteole size and seed and capsule morphology. Although the distinctions between *Dipteracanthus* and *Brunoniella* are quite marked, the same is less so for the genera *Pararuellia*, *Leptosiphonium* F. Muell. (consisting of c. 10 spp. from New Guinea), *Brunoniella* and *Ruellia* s.s. and all should be reconsidered together in any Malesian revision. The character in particular need of study is the inflorescence. Bremekamp separated *Pararuellia* and *Brunoniella* on the basis of the terminal inflorescences of the former and the axillary inflorescences of the latter. However, some *Brunoniella* species described here for Australia have terminal inflorescences overall, even though the flowers may be arranged in clusters in the axils, and it seems that this difference may not be upheld. Whether the pollen distinctions recognized by Bremekamp (1964) between these two genera remain valid, awaits a survey of pollen.

Besides the four Australian species already recognized for *Brunoniella*, for which a summary of name changes is given in Table 11, a further two species and a new subspecies are described here.

Basionym	Nees (1847a)	Clarke (1907)	Bremekamp (1964)
<i>Ruellia australis</i> R. Br. (1810)	<i>Cryphiacanthus australis</i>	<i>Aporuellia australis</i>	<i>Brunoniella australis</i>
<i>R. acaulis</i> R. Br.	? <i>C. acaulis</i>	<i>A. acaulis</i>	<i>Brunoniella acaulis</i>
<i>R. pumilio</i> R. Br.	<i>Dipteracanthus pumilio</i>	—	<i>Brunoniella pumilio</i>
<i>R. spiciflora</i> F. Muell. ex Benth. (1868)	—	<i>A. spiciflora</i>	<i>Brunoniella spiciflora</i>

Table 11: Name changes associated with previously recognised species of *Brunoniella*.

**Brunoniella** Bremek., Proc. Kon. Ned. Akad. Wetensch., Ser. C, 67 (1964) 305; Jacobs & Pickard, Pl. N.S. Wales (1981) 61; Beadle, Evans & Carolin, Fl. Sydney Region 3rd edn (1982) 506.

*Type species: B. acaulis* (R. Br.) Bremek. from Australia.

*Cryphiacanthus* auct. non Nees: Nees in A. DC., Prodr. 11 (1847) 198, p.p. (as to *C. australis*) and 154 p.p. (as to *Ruellia acaulis* R. Br. questionably referred to *Cryphiacanthus*); nom. illeg.

*Type species: C. barbadensis* Nees = *Ruellia tuberosa* L.

*Dipteracanthus* auct. non Nees: Nees in A. DC., Prodr. 11 (1847) 124, p.p. (as to *D. pumilio*); Harris, Wild Fl. Austral. 4th edn (1958) 152; Beadle, Evans & Carolin, Hdbk. Vasc. Pl. Sydney District (1963) 412.

*Ruellia* auct. non L.: Benth, Fl. Austral. 4 (1868) 545, p.p. (as to Sect. *Cryphiacanthus*); Lindau in Engler & Prantl, Nat. Pflanzenfam. IV, 3b (1895) 309, p.p. (as to *R. pumilio* included under Sect. *Dipteracanthus*); F.M. Bailey, Qld Fl. 4 (1910) 1144, p.p. (as to Sect. *Cryphiacanthus*).

*Aporuella* auct. non C.B. Clarke: C.B. Clarke, J. Asiat. Soc. Bengal 74 (1907) 649, p.p. (as to *R. acaulis* R. Br., *R. spiciflora* and *R. australis* listed as referable to *Aporuella*); Domin, Biblioth. Bot. 89 (1929) 602.

*Type species: A. axillaris* Clarke = *Dipteracanthus ventricosus* Nees (Bremek. & Nannenga-Bremek. 1948).

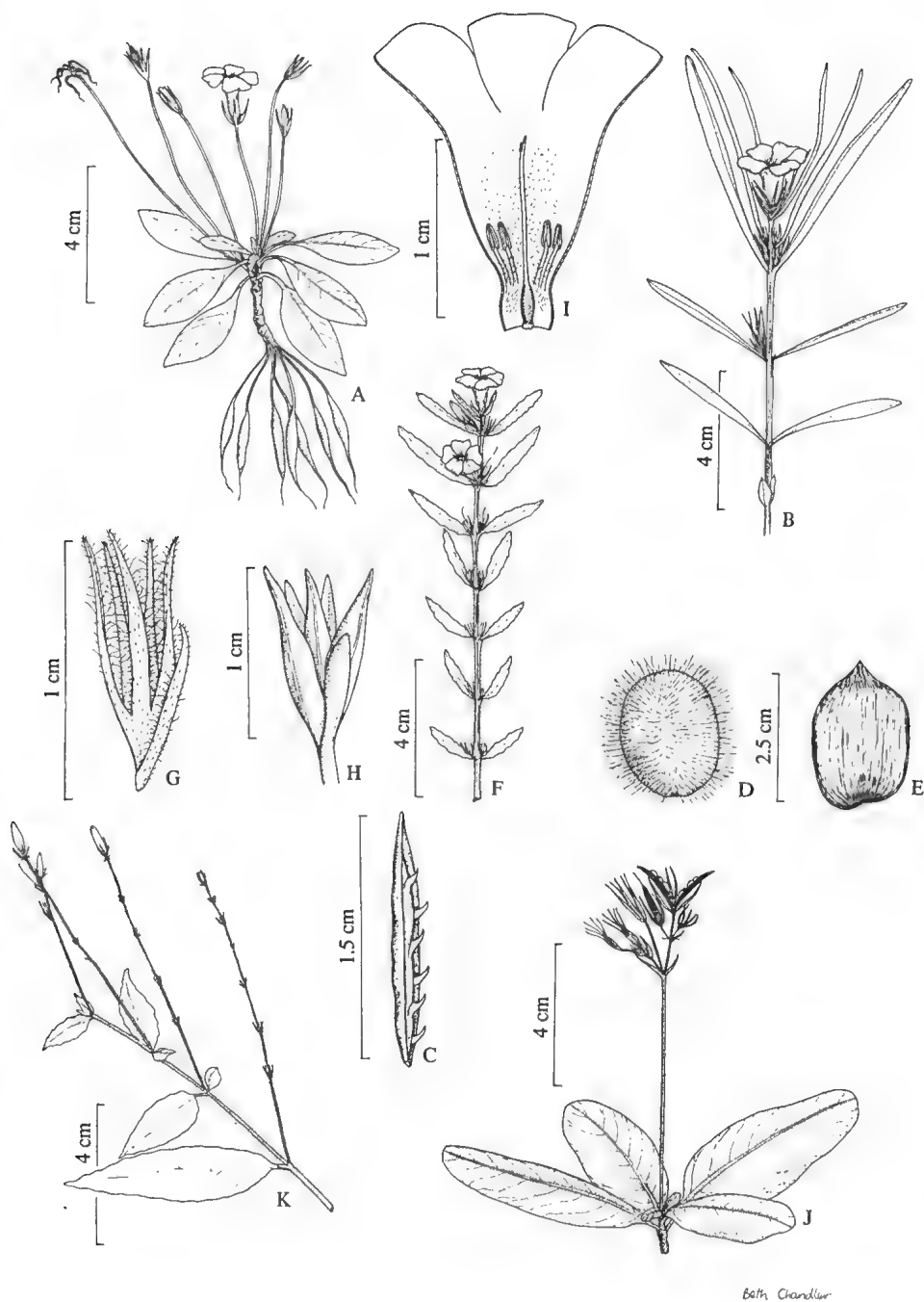
Small, prostrate or erect, perennial, tuberous herbs, with cystoliths. *Branches* angled, sometimes grooved longitudinally, ? sometimes condensed. *Leaves* petiolate, usually indistinguishable from flower subtending bracts, the latter sometimes smaller, opposite pairs joined by a transverse ridge, sometimes unequal, margin entire or shortly-toothed. *Inflorescence* axillary, or ? terminal, solitary flower at apex of long pedicel, or cyme or dichasium at apex of long peduncle, or a loose spike, or flowers 2-many and sessile in axillary clusters; flowers showy or smaller, closed, ? self-fertile. *Bracteoles* 2, shorter than calyx, narrow-lanceolate. *Calyx* segments 5, equal, linear. *Corolla* funnel-shaped, with slight constriction at ovary apex or base of filaments; lobes 5, spreading. *Stamens* 4, very rarely (see *B. australis*, Note 3) 3 or 6, inserted at slight constriction in tube, included, sub-didynamous, not accompanied by staminodes; filaments glabrous or hairy; anthers 2-celled, two cells inserted at same level, more or less parallel, linear, equal, not awned. *Disc* thin, annular with irregular margin, inconspicuous. *Ovary* with 6-10 superposed ovules per cell, glabrous; style glabrous or hairy towards apex; stigma equally or unequally 2-lobed, pubescent. *Capsule* cylindrical, glabrous, 2-12-seeded over entire length, often not all ovules developing into seed; hooks conspicuous, only developing fully under maturing seed. *Seed* discoid to ellipsoid, apex acute, covered with mucous hairs which expand on wetting. Fig. 11.

### Distribution

Apart from an extension of range of one species into southern New Guinea, *Brunoniella* consists of six species confined to Australia. These are found on the east coast of New South Wales and Queensland, in the Darwin area of Northern Territory and in the Kimberleys region of Western Australia.

### Notes

1. Species concept in *Brunoniella*. Of the six species of *Brunoniella* there are two pairs in which the species are superficially very similar to each other. There is no evidence of overlap between species of the first pair, *B. acaulis* and *B. sp.*, which appear to be indistinguishable vegetatively. However, this may be because *B. sp.* is only represented by very few collections. The second pair of species, *B. australis* and *B. pumilio* are usually quite easily separable by their calyx lobe differences (see key), but there are a few specimens from the Darling Downs region of South Queensland which show intermediacy in this character.



Bath Chandler

Fig. 11. *Brunoniella*. A, *B. acaulis* (R. Br.) Bremek., whole plant with tuberous roots (Craven 2265). B-E, *B. linearifolia* R.M. Barker. B, habit (Lazarides 6999); C, half a capsule; D, dry seed; E, wet seed with expanded mucilaginous hairs (C-E, R.M. Barker 528). F-G, *B. australis* (Cav.) Bremek. F, habit (Henderson 187); G, calyx (Solling 516); H-I, *B. pumilo* (R. Br.) Bremek., H, calyx; I, section of flower (H-I, Coveny 5351); J, *B. sp.*, habit and inflorescence (Byrnes 1275); K, *B. spiciflora* (F. Muell. ex Benth.) Bremek., habit (Clemens BRI 138155).



These two species pairs are themselves closely allied. Although usually very distinctive in habit and inflorescence type, *B. acaulis* and *B. australis* in some locations overlap in inflorescence variation, with occasional pedicellate flowers characteristic of *B. acaulis* occurring amongst the predominantly clustered, sessile inflorescences of *B. australis*. The reasons for this are not known. It has been postulated that it may be connected with the breeding system (*B. acaulis* Note 2), or that hybridism is involved (*B. australis*: Note 2). In addition, the distinctive calyx shape of *B. pumilio* is also found in *B. acaulis* ssp. *ciliata*, although these two taxa are widely separated geographically.

Apart from *B. spiciflora* and *B. linearifolia*, which are easily distinguishable from the other four species, it is possible that the other taxa might be better treated at an infraspecific level. Until more is known about the pattern of variation where species are sympatric, their ecological preferences, their breeding patterns and their ability to hybridise, distinction at the species level has been maintained.

As with other members of the tribe Ruellicae there are apparently cleistogamous flowers present and their contribution to the breeding pattern of species in the genus needs to be ascertained.

2. One of the new species of *Brunoniella*, *B. sp.*, has not been named because of its resemblance to the genus *Pararuellia*. I have not had the opportunity to examine any quantity of material or types of this Malesian genus, but specimens in CANB which have been determined as *Ruellia napifera* Zoll. (= *Pararuellia napifera* (Zoll.) Bremek.) at least superficially bear a close resemblance to *B. sp.* *Brunoniella* and *Pararuellia* are closely allied, being separated by Bremekamp (1964) only on their inflorescence position and pollen types.

### Key to species of *Brunoniella*

- 1a. Leaves arranged in a basal rosette, rarely also with a few decumbent branches with opposite leaves. Inflorescence arising from a basal rosette of leaves, long pedicellate and solitary, or pedunculate and cymose (never with glandular hairs on the pedicel or peduncle) ..... 2
- 1b. Leaves not forming a basal rosette, but arranged in opposite pairs along prostrate, decumbent or erect branches. Inflorescence either 1-several more or less sessile flowers in the axils of leaf-like bracts, or an axillary spike with a glandular hairy rachis ..... 3
- 2a. Flowers solitary at the apex of a long pedicel. Bracteoles at base of pedicel within the basal rosette of leaves ..... 1. *B. acaulis*
- 2b. Flowers several, arranged in cymes at the apex of long peduncle. Bracteoles at the apex of the peduncle ..... 2. *B. sp.*
- 3a. Inflorescence an axillary spike with 6-10 remote flowers in the axils of tiny bracts and bracteoles along a densely glandular hairy rachis. Filaments glabrous. Leaf pairs unequal .. 3. *B. spiciflora*
- 3b. Inflorescence of 1-several, more or less sessile flowers in the axils of large leaf-like bracts, the rachis without glandular hairs. Filaments hairy at least in basal part. Leaf or bract pairs equal ..... 4
- 4a. Leaves sessile, narrow-linear, the largest 5-6.5 x 0.2-0.67 cm. Stigma lobes equal. (Flowers 1-2 at each axil) ..... 4. *B. linearifolia*
- 4b. Leaves petiolate, obovate to oblanceolate, 0.5-6.5 x 0.3-3 cm. Stigma lobes unequal ..... 5
- 5a. Calyx lobes linear, in basal half less than 1 mm wide, usually long-setaceous along margins. Flowers several, rarely 2, in dense, more or less sessile clusters in the axils ..... 5. *B. australis*
- 5b. Calyx lobes narrowly-ovate to lanceolate, in basal half more than 1 mm wide, with extremely short, often appressed, hairs (not visible with naked eye) along margins. Flowers solitary or in pairs in the axils, more or less sessile or shortly pedicellate ..... 6. *B. pumilio*

1. ***Brunoniella acaulis*** (R. Br.) Bremek., Proc. Kon. Ned. Akad. Wetensch., Ser. C, 67 (1964) 305. — *Ruellia acaulis* R. Br., Prodr. (1810) 479; Nees in A. DC., Prodr. 11 (1847) 154 (as a questionable *Cryphiacanthus* sp.); F. Muell., N.S. Wales Votes & Proc. Legis. Assemb. 1858-9, (1859) 8; F. Muell., Fragm. Phyt. Austral. 6 (1867) 91; Benth., Fl. Austral. 4 (1868)

547; F. Muell., Syst. Census Austral. Pl. (1882) 99; F.M. Bailey, Syn. Qld Fl. (1883); F. Muell., Sec. Syst. Census Austral. Pl. (1889) 167; F.M. Bailey, Catal. Qld Pl. (1890) 34; F.M. Bailey, Qld Fl. 4 (1901) 1145; C.B. Clarke, J. Asiat. Soc. Bengal 74 (1907) 650; C.B. Clarke in King & Gamble, Mat. Fl. Malay Penins. 4 (1907) 860; F.M. Bailey, Compr. Cat. Qld Pl. (1913) 374, f. 349. — *Aporuellia acaulis* (R. Br.) Domin, Biblioth. Bot. 89 (1929) 603.

*Holotype*: Banks & Solander s.n., 1770, Bustard Bay, Bay of Inlets and Cape Grafton (BM).

Herb, more or less prostrate, with short woody unbranched stem with a basal cluster of roots, each expanded below into narrow, elliptical, 2-3 x 0.5 cm tubers, and an apical rosette of leaves, rarely with a few short decumbent branches arising from within the leaves. *Leaves* with petioles 8-20 mm long; blade ovate to oblong, 2-6.5 x 1-2.5 cm, more or less equal within opposite pairs, attenuate or obtuse at base, entire or somewhat crenulate, obtuse at apex, often red when young, later pale to dark green, with linear cystoliths on upper surface, more or less glabrous apart from hairs on midrib and margins to densely hispid all over. *Inflorescence* of solitary flowers on long pedicels arising from axils of basal rosette, very rarely with some axillary, long or short pedicellate flowers as well on the short, decumbent branches. *Bracteoles* at base of pedicel within the basal rosette, narrow-linear, 4 mm long. *Pedicel* (0.8)-1-6 cm long, eglandular hairy. *Calyx* variable: see subspecies. *Corolla* blue, rarely maroon (Kenneally 7863); tube 3-3.5 mm long; throat 9-11 mm long; lobes 7.2-8.5 mm long; indumentum variable: see subspecies. *Stamens* with filaments 2 mm long, flattened basally, pubescent; anther cells 2 mm long, with connective shortly produced above. *Ovary* with 6-10 superposed ovules per cell; style glabrous, 5.5-6 mm long; stigma unequally 2-lobed. *Capsule* 13-17 mm long, with 2-6 mature seeds in each valve, with hooks well developed only when subtending mature seed. *Seed* 2.2-2.4 x 1.7-1.9 mm. Fig. 11A.

### Typification

The Banks & Solander collection which consists of 6 whole plants in fruit is considered to be the holotype of *Ruellia acaulis* as it is the only one referred to in the protologue (Brown 1810). Within Brown's unpublished manuscript one of his own collections (no. 7 from Keppel Bay collected on August 10th, 1802) has been named *R. acaulis*; a collection from the inner entrance of Thirsty Sound, mounted on the same sheet as Brown 7, has also been annotated 'Ruellia acaulis'. However, Brown's collections were subsequently labelled 'Ruellia australis' by him in keeping with their lack of mention in the protologue. They therefore cannot qualify as type material of *R. acaulis*. Furthermore, Brown's collections have characteristics of both *B. acaulis* and *B. australis* (see Note below and *B. australis*: Typification, Note 2).

### Distribution

*B. acaulis* is distributed across the northern tropical parts of Australia. It consists of two subspecies, one widespread through the species range, the other rarely collected and poorly known. Fig. 12.

### Note

There is considerable variation in this species in indumentum and leaf size. (see Note 1: ssp. *acaulis*). In addition there are some plants (usually older specimens which may be shortly erect) in which the inflorescences contain shortly pedicellate flowers in the axils as well as the typical longer pedicellate flowers thus showing an approach to *B. australis* (Note 2 under that species). There is some evidence (e.g. in Armit 286, Karsten MEL 101273) that these shorter pedicellate flowers are smaller in size and thus may be cleistogamous. Breeding studies of the two species, *B. australis* and *B. acaulis* are required to clarify their relationships.

Key to subspecies of *B. acaulis*

- 1a. Calyx segments linear, 0.6-1.3 mm wide, with eglandular hairs all over. Corolla internally glabrous in throat, except at point of insertion of stamens ..... a. ssp. *acaulis*
- 1b. Calyx segments narrowly ovate to lanceolate, 2.6-3.2 mm wide, glabrous apart from ciliate hairs on margins and sometimes midrib. Corolla internally with lax hairs throughout throat ..... b. ssp. *ciliata*

a. ssp. *acaulis*

*Aporuella acaulis* (R. Br.) Domin “form or variety *glabrescens*” Domin, Biblioth. Bot. 89 (1929) 603.

Probable holotype: Domin I, 1910, Cape Grafton (PR) n.v.

*Calyx* segments linear, 9.2-12 x 0.6-1.3 mm, externally with eglandular hairs all over, internally with long, appressed, eglandular hairs. *Corolla* externally more or less glabrous apart from a few hairs on margins of lobes, internally glabrous except at point where stamens are inserted.

Distribution

Ssp. *acaulis* occurs in eastern coastal Queensland, Cape York Peninsula and Arnhem Land, with single records from the Kimberleys of Western Australia and the Western District of Papua New Guinea. Fig. 12.

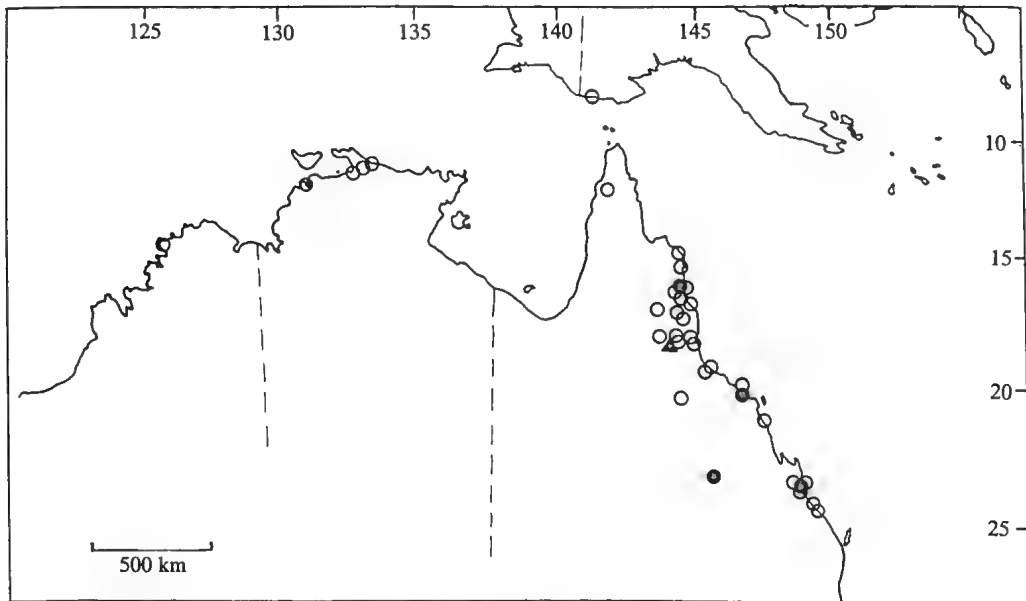


Fig. 12. Distribution of *Brunoniella acaulis* (○ ssp. *acaulis*; ● aff. ssp. *acaulis*; ▲ ssp. *ciliata*).

## Ecology

Ssp. *acaulis* has been recorded from “grassland with ironbark and sandalwood”, from “*Eucalyptus confertiflora* and *E. cullenii*” woodland and from “open woodland of *Melaleuca viridiflora* and *Eucalyptus*”. It has in a number of cases been recorded from clay soils on basalt and from clay forest country. Flowering specimens have been collected most commonly in October to January, with a few records in July and March; fruiting specimens are known from November to March.

## Notes

1. The single Kimberleys collection, *Kenneally* 7863, and the collection *Craven* 2265 from the Darwin area are probably deserving of at least varietal status as they are more or less completely glabrous all over compared with the often extremely hispid Queensland collections seen. Domin (1929) refers his own collection from Cape Grafton, near Cairns to a “form or variety *glabrescens*” of *Aporuella acaulis*. I have not seen the Domin collection and do not know whether it is allied to the Darwin and Kimberleys collections. Owing to the paucity of glabrous specimens, their extreme disjunction and the unreliability of hair covering as a taxonomic character in other genera of Acanthaceae in Australia, it seems better not to formally recognise the specimens. Flower colour also needs to be investigated as the flowers are recorded as maroon by *Kenneally* whereas the usual colour is blue.

2. A note on *Bates BRI 137327* carries the information that the bulbs are “good eating even raw, taste something like sweet potato”. Utilisation by aborigines may therefore account for the very disjunct Kimberley collection. Inadequate collecting may provide an alternative reason.

## Specimens examined

NORTHERN TERRITORY: *Byrnes* 1295, 21.i.1969, 2 miles E Middle Harbour Jetty, Darwin (DNA — 2 sheets, NT); *Craven* 2265, 15.ii.1973, 12° 04'S, 133° 00'E (CANB); *Dunlop* 3266, 16.ii.1973, East Alligator River (DNA); *Latz* 3895, 15.iv.1973, Munmarlary Stn (NT).

QUEENSLAND: *Anon. s.n.*, 12.i.1964, Reid River (BRIU S-3894); *Anon. (Fitzalan) s.n.*, s. dat. Port Denison (MEL 602027, MEL 602024); *Anon. (Mueller) s.n.*, s. dat. (MEL 602026); *Armit* 286, 1876, Cashmere (MEL); *Bates s.n.*, 30.xi.1942, around Cairns (BRI 137337); *Berney* 34, s. dat. Helenslee, Campaspe River, (BRI); *Blake* 9905, 18.x.1935, Pentland (BRI); *Blake* 22491, 26.iii.1966, Curtis Island, South end (BRI); *Bowman* 281, s. dat., Broadsound (MEL); *Broom* 17, 1892, [? Muldiva], (MEL); *Brown* 2943 p.p., 1802, Keppel Bay and Thirsty Sd (BM: p.p.); *Brown s.n.*, s. dat. Bustard Bay, Bay of Inlets and Cape Grafton (BM); *Cassels (Flecker Herb. 14901)*, xi.1967, Mt Carbine (QRS); *Clarkson* 2677, 11.xi.1979, W of road from Ravenshoe to Koombooloomba Dam (BRI); *Dallachy s.n.*, 29.vii.1867, Bogia R (MEL 602023); *Dietrich* 2475, s. dat. Port Mackay (MEL); *Dietrich* 112, s. dat. Gladstone (MEL p.p.); *Dockrill* 1561, 9.i.1979, nr Granite Ck at Channel Rd Crossing (QRS); *Dovey s.n.*, s. dat., Rosedale (BRI 137332); *Fawcett* 367, s. dat. Townsville (BRI); *Fitzalan s.n.*, s. dat. Port Denison (MEL 602025, K p.p.); *Flecker (Herb. Flecker 4150)*, 15.i.1938, Nome (QRS); *Flecker (Herb. Flecker 10854)*, 12.iv.1947, Cook Highway, Pretty Beach (QRS); *Karsten s.n.*, 1881, near Trinity Bay (MEL 101273); *Morain* 222, 31.x.1967, N of Wairuna Stn, c. 40 m S of Mt Garnet (BRI); *Sayers s.n.*, 1886, Mossman River (MEL 100706); *Scarth-Johnson* 540A, 22.vii.1977, Hopevale (BRI); *Scarth-Johnson* 861A, 17.x.1979, York Stn (BRI); *Specht & Salt W208*, 9.xii.1974, 23.5 km ENE of Weipa Mission (BRI); *Staples* 2027, 25.iii.1975, DPI Experimental Plots, Boomerang Stn, via Mt Garnet (BRI); *Smith, T. 21*, 21.vii.1942, between Cluden & Stuart (BRI); *Thorsborne* 302, 20.x.1976, c. 6 km NNW of Cardwell (BRI); *Thorsbofjorne s.n.*, 16.xii.1970, Resort site, Cape Richards, Hinchinbrook Island (BRI); *Volck* 4423, iii.1970, Cooktown (BRI); *Volck* 4741, Cardwell (BRI); *Webb & Tracey* 5527, 17.i.1962, ½ m S of Mareeba on Atherton Rd (BRI); *White s.n.*, 11.ii.1918, Townsville (BRI 137329).

WESTERN AUSTRALIA: *Kenneally* 7863, 21.i.1982, 1.5 km SE of CRA Mining Camp, Mitchell Plateau, N. Kimberley (PERTH).

PAPUA NEW GUINEA: *Brass* 8474, xii.1936. Penzara, between Morehead and Wassi Kussa Rivers, Western Division (LAE).

AUSTRALIA WITHOUT LOCALITY: *Anon. s.n.*, s. dat. N. Australia (AD 96307251).

## Specimen approaching ssp. *acaulis*

QUEENSLAND: *Thozet* 7, s. dat. Suttor R. (MEL 602022).

b. ssp. *ciliata* R.M. Barker, ssp. nov.

Subspecies nova *B. acaulis*, a ssp. *acauli* differt segmentis calycis glabris ciliatis latioribus et fauce corollae pilis laxis.

*Holotype*: Birch s.n., 1890, Junction Creek (MEL 100699).

*Calyx* segments narrowly ovate to lanceolate, c. 11.5 x 2.6-3 mm, externally glabrous, with margins and sometimes midrib ciliate, internally with long, appressed, eglandular hairs. *Corolla* externally with fine eglandular hairs on all parts, internally with weak eglandular hairs throughout throat.

*Distribution*

Ssp. *ciliata* is known only from five collections all made in the last century and all from Queensland. Only one location, Glen Dhu Creek in Northern Queensland, can be pinpointed; of the other collections one is without a specific locality, while another comes from Junction Creek, an extremely common name within Queensland. I have been unable to determine the collecting localities of C.W. Birch and this may help in deciding which is the Junction Creek referred to. Fig. 12.

*Ecology*

Nothing is known except for the annotation "stony ground" on the Glen Dhu Creek collection.

*Notes*

1. The presence of hairs throughout the corolla tube and throat of this subspecies is unique in the genus and coupled with the differently shaped calyx segments, means that the subspecies now recognised is perhaps deserving of species rank. However, the paucity of collections and the possible unreliability of the calyx segment character (Note 2) has led to infraspecific recognition.

2. There are two specimens (*Anon. MEL 602024*, *Anon. MEL 602029*) which approach ssp. *ciliata* in the width of calyx segments (1.6-2.6 mm). However, the segments are slightly more hairy all over and the corolla throat lacks any hairs, thus aligning them with ssp. *acaulis*. Two other specimens (*Blake 22491*, *Younger BRI 169061*) also approach the new subspecies in calyx characteristics, but both lack flowers and so cannot be reliably placed.

*Specimens examined*

QUEENSLAND: *Anon. s.n.*, s. dat., Burnett River (K p.p.); *Anon. 96*, s. dat. Glen Dhu Creek (MEL 602028); *Anon. s.n.*, s. dat. Eastern tropical Australia (MEL 602026); *Birch s.n.*, 1890, Junction Ck (MEL 100699: holotype); *Birch s.n.*, 1891, Junction Ck (MEL 100703).

*Specimens approaching ssp. ciliata*

QUEENSLAND: *Anon. s.n.*, s. dat., Port Denison (MEL 602024); *Anon. s.n.*, s. dat. R. Daintree (MEL 602029); *Blake 22491*, 26.iii.1966, Curtis Island, south end (BRI); *Younger s.n.*, 22.ii.1974, Medway Station, c. 12 km SSE of Bogantungan, west of Emerald (BRI 169061).

2. *Brunoniella* sp.

Prostrate herb with rosette of leaves, ? tuberous. *Leaves* and flower subtending bracts with short (0.5 cm) broad petiole; blade broadly ovate to somewhat spatulate, 2-5.3 x 1.4-3.7 cm, opposite pairs becoming equal with age, obtuse at base and apex, entire or crenulate, upper surface dark green, paler veins and numerous small linear cystoliths on all parts, more or less glabrous, lower surface paler, main lateral veins and midrib elevated, sparsely hairy.

*Inflorescence* a cyme or triad at apex of a long, erect peduncle arising from basal leaf rosette. *Peduncle* 3.3-8 cm long, flattened, with moderately dense eglandular hairs. *Bracteoles* lanceolate, sparsely pubescent, particularly on margins and midrib at apex, 8 mm long, those subtending lateral flowers smaller. *Pedice* 3-21 mm long, eglandular hairy. *Calyx* segments linear-lanceolate, 10.5-17.5 x 0.9-1 mm, externally hairy, margins setaceous. *Corolla* mauve, constricted about ovary, externally hairy, internally glabrous except for ring of ciliate hairs at constriction and point of insertion of stamens; tube 2.5 mm long; throat 5.5 mm long; lobes 6 mm long. *Stamens* with filaments in slightly unequal pairs, 1 and 1.5 mm long, hairy at base; anther cells 2.1 mm long, connective not produced above them. *Ovary* with 4 superposed ovules per cell; style glabrous, 4.5-6.6 mm long; stigma unequally 2-lobed. *Capsule* 13.5-17.5 mm long, 4 seeds in each valve, all on well developed hooks. *Seed* c. 2.5-3 x 1.8-1.9 mm. Fig. 11G.

### *Distribution and ecology*

Known only by two collections from the Daly River Road in the Northern Territory (Fig. 13). These are from "open *Eucalyptus* forest", one from 'Tipperary soil', the other from 'deep red loam'. Flowering occurs in December-January.

### *Note*

There are several reasons why it was considered premature to formally name this species. As with a number of species of *Brunoniella*, *B. sp.* is possibly more widespread than collections indicate; the flowering time of December-January, corresponding with the northern Australian wet season and consequent difficulty of collecting, may have contributed to the paucity of collections. Secondly, it seems to be related to *B. acaulis* (R. Br.) Bremek.; they differ only in inflorescences being cymose versus solitary. *B. sp.* is vegetatively close to the Byrnes collections of *B. acaulis* from 2 miles E of Middle Harbour Jetty, Darwin. The species also needs to be compared with *Pararuellia* species from Malesia which are vegetatively very similar to the basal-rosetted species of *Brunoniella*. *B. sp.* appears to be similar to CANB material from West Flores which has been determined as *Ruellia napifera* Zoll. (= *Pararuellia napifera* (Zoll.)

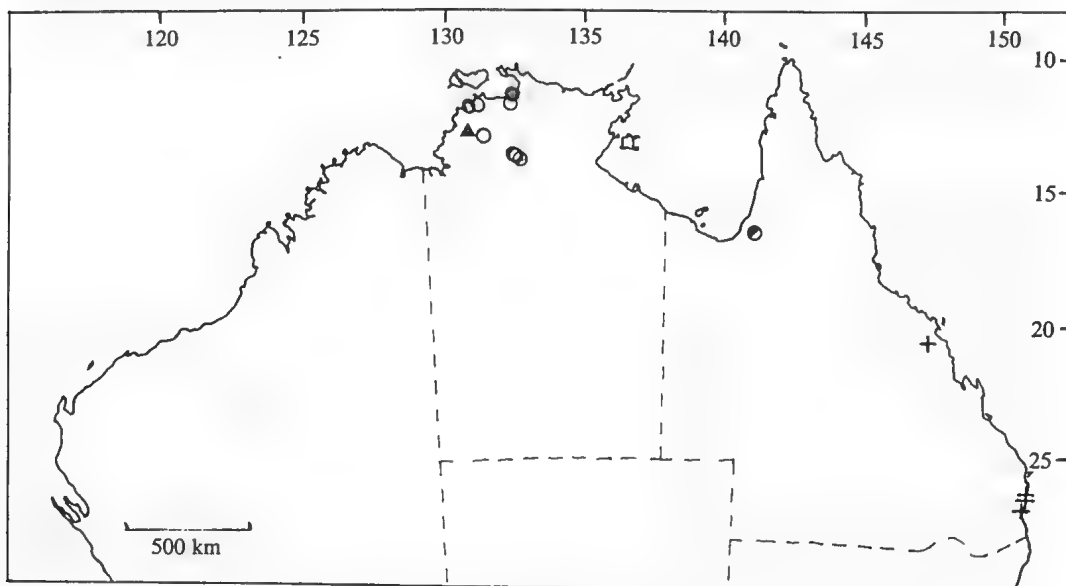


Fig. 13. Distribution of ▲ *B. sp.*; ○ *B. linearifolia*; ● *aff. B. linearifolia*; ◐ *B. linearifolia* (locality uncertain); + *B. spiciflora*.

Bremek., Bremekamp 1948). This is possibly a misidentification as the inflorescence in *Pararuellia* is described as a spike. The matter needs to be investigated further before a name can be applied with any certainty to this taxon from Northern Territory.

### *Specimens examined*

NORTHERN TERRITORY: *Byrnes 1242*, 19.xii.1968, Daly R. Road, 15 m W Highway (CANB, DNA, NT); *Byrnes 1275*, 10.i.1969, Foster Block, Daly R. Rd (CANB, DNA, K, NT — 2 sheets).

3. ***Brunoniella spiciflora*** (F. Muell. ex Benth.) Bremek., Proc. Kon. Ned. Akad. Wetensch., Ser. C, 67 (1964) 305. — *Ruellia spiciflora* F. Muell. ex Benth., Fl. Austral. 4 (1868) 547; F. Muell., Syst. Census Austral. Pl. (1882) 99; F.M. Bailey, Syn. Qld Fl. (1883) 368; Shirley, Proc. Roy. Soc. Qld 5 (1888) 139; F. Muell., Sec. Syst. Census Austral. Pl. (1889) 167; F.M. Bailey, Catal. Qld Pl. (1890) 34; F.M. Bailey, Qld Fl. 4 (1901) 1145; C.B. Clarke, J. Asiat. Soc. Bengal 74 (1907) 650; F.M. Bailey, Compr. Cat. Qld Pl. (1913) 374. — *Aporuella spiciflora* (F. Muell. ex Benth.) Domin, Biblioth. Bot. 89 (1929) 603.

*Lectotype here designated: Leichhardt s.n.*, 10.ix.1843, Archer's Creek [near Durundur] (MEL 601746); *isolectotype: K.*

?Erect, ?tuberous herb with simple, eglandular hairy stems, leaves spaced along stems. *Leaves* with petioles 3-8 mm long blade ovate, opposite pairs unequal, the larger 38-91 x 1.2-2.5 mm, the smaller 1/10-½ length of larger, obtuse at base, serrulate, acute or more rarely obtuse at apex, upper surface with small linear cystoliths, more or less glabrous, midrib sometimes densely hairy from continuation of hairs from stem and petiole, lower surface paler, eglandular hairs more dense on midrib and main lateral veins, sparsely elsewhere. *Inflorescence* a slender, axillary spike with 5-6 remote flowers, one flower developing at each node. *Rachis* to 5 cm long, densely glandular hairy. *Bracts* one on either side of rachis, small (2.2 mm long), linear, hairy. *Bracteoles* 2 per flower at base of pedicel, smaller (1.9 mm long) than bract, similar shape. *Pedicel* 0.5 mm long. *Calyx* segments linear, 4.8-6.5 x 0.5-0.6 mm, glandular pubescent. *Corolla* colour unknown, externally eglandular hairy all over, internally glabrous except for basal half of throat; tube 3-4.4 mm long; throat 9-10 mm long; lobes 5-7.5 mm. *Stamens*: filaments c. 2.5 mm long, glabrous; anther cells 1.9 mm long, connective not extended at apex. *Ovary* with ? 6 superposed ovules per cell; style 7.5 mm long, eglandular hairs in upper half; stigma unequally 2-lobed. *Capsule* 12.5 mm long, seedless at base, 4-seeds with well-developed hooks, c. 8 vestiges of hooks above. *Seed* 2-2.5 x 1.1 mm. Fig. 11H.

### *Distribution*

Three of the five collections seen come from coastal areas north of Brisbane, with one other locality from Dalrymple Heights (= Eungulla) near Mackay. This last named collection was the most recent record, having been made in 1947. Fig. 13.

### *Ecology*

The only indications of ecological habitat are from "scrub" about Maroochie and from 'creek sides scrub' from Noosa. Flowering specimens were collected in September and October.

### *Notes*

1. *B. spiciflora* is easily distinguishable from other *Brunoniella* representatives by its axillary spikes, the rachises of which are glandular hairy, as well as the unequal pairs of leaves.

2. It is likely that this species is extinct, or nearly so, as it is represented by so few specimens all of which are from heavily developed coastal areas north of Brisbane. The Noosa Heads National Park may be one area worthy of investigation if the species is to be located again.

### *Specimens examined*

QUEENSLAND: *Anon. [Bailey] s.n.*, x.1874, Maroochie (BRI 141173); *Colonial Botanist, Brisbane s.n.*, s. dat. without specific locality (AD 96307242); *Clemens s.n.*, vi-xi.1947, Dalrymple Heights and vicinity (BRI 138155 & BRI 138156, K); *Longman s.n.*, ix.1913, Noosa (BRI 141172, K); *Leichhardt s.n.*, 10.ix.1843, Archers Creek (MEL 601746, K).

### 4. *Brunoniella linearifolia* R.M. Barker, sp. nov.

Species nova, differt a *B. australi* et *B. pumilio* foliis linearibus, sessilibus, a *B. spiciflora* floris in racemo terminali et foliis in paribus aequalibus et a *B. acauli*, *B. sp.* que habitu erecto et floribus sessilibus.

*Holotype*: Lazarides 6999, 18.xii.1963, on Stuart Hwy, 16 miles SE of Katherine (CANB 129081); *isotypes*: (CANB 137717, NT).

Erect, ?tuberous herb, to 15 cm high, with angled or grooved, glabrous or eglandular hairy branches, with numerous small cystoliths and well-spaced leaves. *Leaves* and flower subtending bracts indistinguishable, sessile, linear, 5-6.5 x 0.2-0.67 cm in apical parts, smaller (c. 1-2 x 0.25 cm) lower down, opposite pairs more or less equal, entire, rarely more or less serrate, apex obtuse, rarely acute, upper surface with numerous small cystoliths, glabrous or with a few sparse hairs, lower surface sparsely hairy. *Inflorescence* 1-2, sessile or very shortly pedicellate, flowers in axils of upper leaves or bracts, combined into a terminal raceme. *Bracteoles* shorter than calyx, linear, 5-13.5 x 0.6-0.8 mm, more or less glabrous except for few hairs on margins, or sparsely hairy all over. *Pedice* 0-0.5-(3) mm long, indumentum similar to calyx. *Calyx* segments linear, 12-15 x 0.6-0.8 mm, sparsely eglandular hairy on margin and midrib or all over. *Corolla* blue or mauve, rarely white, externally hairy all over or hairy on throat and margins of lobes (best seen in bud), internally hairy on adaxial side of throat; tube 2-2.8 mm long; throat 6.7-10.5 mm long; lobes 4.9-10.5 mm long. *Stamens* with filaments c. 2 mm long, hairy at least towards base, sometimes for entire length; anther cells c. 1.5 mm long; connective forked at apex, rarely (*Rankin 1553*) acute, extended 0.3 mm past cells, appearing sagittate overall. *Ovary* with 4 superposed ovules per cell; style hairy in upper part, 5.3-6.5 (-8) mm long; stigma with more or less equal lobes, c. 1 mm long. *Capsule* 14-18.5 x 4-4.5 mm, glabrous with 2-3 (4) mature seeds per valve, each mature seed subtended by well developed hook. *Seed* c. 2.5 mm x 1.8 mm. Fig. 11B.

### *Distribution*

*B. linearifolia* has been collected near Darwin and Katherine (Fig. 13) in the Northern Territory.

### *Ecology*

It has been recorded from 'alluvial' or 'heavy clay' flood-plains, sandy soil on a creek margin and 'gentle slopes in sandy soil with *Eucalyptus tetradonta* and *Heteropogon triticeus*'. Flowering specimens have been collected from November to January.

### *Note*

This species is unique in *Brunoniella* by the possession of linear, sessile leaves, and equal stigma lobes. It comes closest to *B. australis* from which it differs only by the single or paired flowers in the axil, and *B. pumilio* from which it differs by the narrow linear calyx lobes.



*Specimens examined*

NORTHERN TERRITORY: *Anon. (Holtze) 1246*, s. dat., (MEL 101281); *R.M. Barker 525*, 11.v.1983, 26.2 km SE of Katherine on Stuart Hwy (AD); *R.M. Barker 528*, 11.v.1983, Stuart Hwy, 58.8 km SE of Katherine (AD); *Byrnes 1256*, 24.xii.1968, Elizabeth River (NT, DNA); *Byrnes 1281*, 21.i.1969, Elizabeth River (NT, CANB, DNA — 2 sheets, K); *Collins 131*, 4.xii.1976, Kapalgga Ref. 0709 (DNA, CANB); *Lazarides 6999*, 18.xii.1963, on Stuart Hwy, 16 m SE of Katherine (CANB: 2 sheets, NT); *Must 1304*, 26.xi.1974, Darwin River (NT, DNA); *Rankin 1553*, 8.xi.1978, Horn's Creek (DNA); *Robinson 253*, 16.i.1964, between Douglas Block and River (NT).

?QUEENSLAND: *N. Holtze 1370*, 1892, Glencoe Stn (MEL).

Specimen aff. *B. linearifolia*

NORTHERN TERRITORY: *Latz 3798*, 10.v.1973, Munmarlary Stn (NT).

**5. *Brunoniella australis* (Cav.) Bremek.**, Proc. Kon. Ned. Akad. Wetensch., Ser. C, 67 (1964) 305; Beadle, Evans & Carolin, Fl. Sydney Region (1972) 504 (author cited as (R. Br.) Bremek. for this and following references); Rotherham et al., Fl. Pl. N.S. Wales & S. Qld (1975) 77, pl. 222; Williams, Nat. Pl. Qld (1979) 42; Jacobs & Pickard, Pl. N.S. Wales (1981) 61; Beadle, Evans & Carolin, Fl. Sydney Region (1982) 506; Cunningham et al., Pl. N.S. Wales (1981) 605 with pl. — *Ruellia australis* Cav., Icon. 6 (1801) 62; Benth. in Maund, Botanist 4 (1840) pl. 177 (as to name only: see Note 5).

*Lectotype here designated: Née 45*, iii.1793, New Holland (Exped. Malaspina) (MA 215082: photograph AD); *isolectotype or syntype: Née 46*, iii.1793, Botany Bay, New Holland (MA 215081 p.p.: right hand specimen only, photograph AD).

*Ruellia australis* R. Br., Prodr. (1810) 479, *nom. illeg.*, non Cav. (1801); Nees in A. DC., Prodr. 11 (1847) 151; Benth., Fl. Austral. 4 (1868) 547; F. Muell., Syst. Census Austral. Pl. (1882) 99; F. Muell., Sec. Syst. Census Austral. Pl. (1889) 167; Tate, Hdbk. Fl. Extratrop. S. Austral. (1890) 253 (as to name only as it does not occur in S.A. and no voucher material found); F.M. Bailey, Qld Fl. 4 (1901) 1145; Clarke, J. Asiat. Soc. Bengal 74 (1907) 650. — *Dipteracanthus australis* Hassk., Hoeven & de Vriese (eds) Tijdschr. Nat. Gesch. Physiol. 10 (1843) 129 (see Note 5 on author citation); Harris, Wild Fl. Austral. 4th edn (1958) 152, pl. 18; Beadle, Evans & Carolin, Hdbk. Vasc. Pl. Sydney District (1963) 412. — *Cryphiacanthus australis* Nees in A. DC., Prodr. 11 (1874) 198. — *Aporuellia australis* Domin, Biblioth. Bot. 89 (1929) 650.

*Lectotype here designated: R. Brown 2943*, 8.vi.1802, Port Jackson (BM p.p., as to bottom 6 specimens); *syntype: R. Brown 2943*, ? xi.1803, ? Vicinitate Sydney (BM, K, p.p.); possible *syntype: Banks & Solander s.n.*, s. dat. Bay of Inlets (MEL 86955, BM).

*Ruellia australis* R. Br. var. *pumila* Benth., Fl. Austral. 4 (1868) 547, p.p. (excluding R. Brown's collections of *R. pumilio* from Port Jackson and *Lau 80*); F.M. Bailey, Qld Fl. 4 (1901) 1145, p.p.; F.M. Bailey, Compr. Cat. Qld Pl. (1913) 374.

*Syntypes: Barton 133*, s. dat. Armadilla (MEL); *Mueller s.n.*, Burdekin River (K); *O'Shanesy 110*, 20.xii.1867, Rockhampton (MEL); *O'Shanesy 43*, 20.xii.1868, Gracemere (MEL); *Anon. [Stuart] 171*, xi, Dry hills about Mogill (MEL) and partly *Lau 80*, 1866, Darling Downs (MEL).

*Ruellia australis* R. Br. var. *scabra* Benth., Fl. Austral. 4 (1868) 547.

*Lectotype here designated: Anon. [Mueller] s.n.*, s. dat. Gilbert River (K); *isolectotype: MEL 86958*; *syntype: Barton 17*, 1867, Armadilla, between the Warrego and Maranoa (MEL).

*Ruellia acaulis* auct. non R. Br.: R. Br., Prodr. (1810) 479, p.p. (at least as to some specimens on the lectotype sheet of *R. australis* R. Br.: see Typification).

Perennial, tuberous, herb, usually prostrate or erect, few-branched and 2-15 cm high, rarely with many diffuse spreading branches and c. 15 cm high, hairy all over or more or less glabrous. *Branches* 4-6-angled, sometimes somewhat flattened and/or grooved on two wider sides. *Leaves* and flower subtending bracts indistinguishable, opposite pairs usually somewhat unequal; petioles 2.5-15 mm long; blade ovate to obovate or oblanceolate, 1.4-6.5 x 0.5-3 cm,

attenuate or obtuse at base, crenulate or entire, acute or obtuse at apex, upper surface with small linear cystoliths, densely scabrous to more or less glabrous, lower surface paler, cystoliths sometimes visible. *Inflorescence* an axillary cluster of usually several, sometimes 2, more or less sessile flowers, occurring in nearly all leaf axils, combined into slender terminal thyrses. *Bracteoles* 2-6.8 mm long, linear, eglandular pubescent at least on margins. *Calyx* segments linear, 6.8-12.5 x 0.4-0.8 mm, shortly pubescent all over, or with eglandular hairs at least on margin. *Corolla* blue, externally hairy or glabrous; large (chasmogamous) flowers with tube 2-4 mm long, throat 3.5-8.2 mm long, lobes 3.5-9 mm long, spreading; smaller (? self-fertile, cleistogamous) flowers with tube 1.2-1.5 mm long, throat 2.7-4 mm long, lobes 2-2.4 mm long, erect. *Stamens* in large flowers 4, hairy filaments 1.5-2 mm long, anther cells 1.1-1.7 mm long; in smaller flowers, (3-) 4 (-6), with pollen shed by opening of flower. *Ovary* in larger flowers glabrous, 5-7 superposed ovules per cell; style 4-7 mm long, glabrous; stigma with 2 unequal lobes; ? smaller flowers differing only by shorter style 2.2-2.5 mm long. *Capsule* 10.5-18 mm long, 1-2 seeds per valve, each with well developed hooks, rest of ovules and hooks not developing. *Seed* 1.7-2.0 x 1.4-1.9 mm. Fig. 11C, D.

### Typification

#### 1. *Ruellia australis* Cav.

There are two sheets in MA, collected by Nee on the Malaspina Expedition when it called into Botany Bay in March 1793 (Hall 1978) on its way back from the Philippines to South America.

Photographs of the collections and close-ups of the calyces of each of the specimens were sent from MA. The sheet with the larger number of collections, MA 215082, from the close-up photographs supplied, consists of 7 fragments of *Brunoniella australis*, while the other sheet, MA 215081, is a mixture of *B. australis* and *B. pumilio*. The former sheet contains better material and has been designated as the lectotype.

#### 2. *Ruellia australis* R. Br. and names based on the same type

The name *Ruellia australis* has usually been attributed to Robert Brown (1810), but it is a later homonym of *Ruellia australis* Cav. (1801). Its typification is, however, important as several legitimate binomials originally based on it have the same type, but are here treated as new names (see Note 5).

There are two sheets in BM containing syntypes. One (Fig. 14) has a mixture of collections. The three specimens in the top left and right hand corners of this sheet obviously relate to Brown's annotation *R. acaulis*, and it is presumably these which come from Queensland since Brown's unpublished manuscript refers to his own collections of *R. acaulis* from Thirsty Sound and Keppel Bay. The remainder of the collections in the bottom half of the sheet must be his collections from Port Jackson, and it is these which have been designated the lectotype. These six specimens are all typical of the slender form of *B. australis* found in the New South Wales area. On the other hand, the two collections on the other BM sheet annotated as *R. australis* are much more robust than the Port Jackson specimens and are probably from the same gathering as the topmost specimens labelled as *R. acaulis* on the lectotype sheet.

The type status of the Banks and Solander collection (MEL 86955, BM) of this species from Bay of Inlets is uncertain. Even though Brown did not cite it in the Prodrômus (1810), he did have access to their material and so it seems likely that the collection is a syntype. It has been annotated "*Ruellia axillaris* Sol." and subsequently (? by Brown) as *R. australis*.

The Queensland collections on the lectotype sheet which are labelled as *R. acaulis* by Brown are somewhat atypical *B. australis* specimens (see Note 2 below). Brown obviously initially thought of them as distinct from his *R. australis* as in his unpublished manuscript he



Fig. 14. Syntypes and lectotype (lower specimens) of *Ruellia australis* R. Br.

specifically refers to these collections as *R. acaulis*. In his later publication (Brown 1810), the only material of *R. acaulis* which he cites as having seen is the Banks and Solander collection (see Typification of *R. acaulis*). There is no indication that he considered the Queensland material should be transferred to *R. australis*.

### 3. *Ruellia australis* R. Br. var. *pumila* Benth.

Bentham's (1868) var. *pumila* consists of a mixture of *B. australis* and *B. pumilio*. Of the six collections he cited, three are *B. australis*, the Brown specimen is *B. pumilio* and *Lau 80* is intermediate between the two species. The Brown specimen from Port Jackson is by far the best available material and the obvious choice for lectotype. If this material is chosen as lectotype of var. *pumila* this would have the advantage that the two confusable names *R. pumilio* R. Br. and *R. australis* R. Br. var. *pumila* Benth. would become nomenclatural synonyms. However, as the majority of the syntypes are referable to *B. australis* there are arguments for selecting one of these specimens as lectotype, in which case the two names will not be synonyms.

### Distribution

*B. australis* is found in north-eastern New South Wales, eastern Queensland, the Torres Strait Islands, the northern parts of the Northern Territory and, on the basis of two recent records, the Kimberley region of Western Australia. Fig. 15.

### Ecology

Ecological records in New South Wales and Queensland indicate that *B. australis* is found in dry sclerophyll forest or woodland (with various *Eucalyptus* species including *E. thozetiana*, *E. confertiflora*, *E. cullenii*, *E. populnea* and *E. melanophloia* and *Myoporum mitchellii*), in brigalow-softwood scrub and on flood-plains. Soil types include sandy, clay loams and red basalt, often in association with rocky outcrops. Flowering occurs between October and June.

### Notes

1. *B. australis* is a variable species. Specimens from northern Queensland and Northern Territory tend to be more robust in habit with larger, very scabrous and often broadly ovate leaves, while those from southern Queensland and New South Wales are usually smaller plants with smaller, more or less glabrous, narrowly ovate leaves. Some specimens are intermediate between these extremes and there are also occasional specimens from one of these regions which are more in keeping with those from the other. It was thought better not to give these variants any formal status.

In addition, specimens show varying degrees of scabridity throughout their distributional range, but this appears to have no ecological correlation. Accordingly, Bentham's (1868) var. *scabra* has not been recognised.

2. *Byrnes 3585* & *Clarkson* from Marlborough and Robert Brown's collections from Keppel Bay and Thirsty Sound, all in Queensland, resemble *B. australis* for the most part. In some of the basal axillary flower clusters, the flowers are pedicellate, a characteristic of *B. acaulis*. As both species occur in this area it is possible that the collections represent hybrids, particularly as the pedicel length is c. 7 mm, at the lower limit of that usually found in *B. acaulis* (8-60 mm).

3. As noted earlier, two different flower types may occur on the same plant. One flower-type is large and conspicuous with spreading corolla lobes and is presumably insect-pollinated. The other is smaller and less conspicuous, with the corolla lobes remaining erect; the flower is

presumably self-pollinated as by the time it opens practically all of the pollen is shed. The only detected differences in the androecium and gynoecium of these two flower types were more variable stamen number in the smaller flower type (*Solling 516* had 6 fully mature stamens, *Looker MEL 86952* only 3 stamens) and shorter style lengths in the smaller flowers. The number of ovules within the ovary is the same for both flower-types and capsules are indistinguishable unless the style remains attached.

4. There is a group of specimens which approach *B. pumilio* in some respects, but which are probably better referred to *B. australis*. The Telford collection (*Telford 5031 & Butler*) from the Lithgow area of New South Wales has pairs of flowers in the axils which are c. 1 cm apart, thus agreeing with *B. pumilio* in habit, but the calyx lobes are narrower than 1 mm and extremely setaceous along the margins, conforming more with those of *B. australis*.

A group of specimens from the Darling Downs area of Queensland have almost glabrous calyx lobes, a characteristic which aligns them with *B. pumilio*. However, the calyx lobes are linear, not ovate, less than 1 mm wide, and the flowers are in pairs crowded in the axils, all characteristics of *B. australis*. As these specimens all come from an area which is between the normal distribution of these two species, they may result from hybridization or represent a clinal intergrade between *B. australis* and *B. pumilio*.

5. The basionym for *B. australis* has had a long history of being attributed to Brown (1810), probably dating from Bentham's citation of the species in *Flora Australiensis* (1868). Bentham was aware of *Ruellia australis* Cav. as a name, as he wrongly attributed a plant in Maund (1840) to this species and cited Cavanilles as the author. Bentham may have been unaware that *R. australis* Cav. and *R. australis* R. Br. were conspecific and this may have been the reason for overlooking Cavanilles authorship in 1868 and attributing *R. australis* to Robert Brown. This oversight was not rectified until Bremekamp (1964) transferred the species to *Brunoniella*. Even so, Cavanilles was still ignored as the correct author citation by later flora writers who accepted the transfer to *Brunoniella*, but still attributed the basionym to Brown.

It should be noted that in the synonymy, in citing the previously published combinations in *Dipteracanthus*, *Cryphiacanthus* and *Aporuella* based on *R. australis* R. Br., R. Br. has been omitted from the author citation and the combination dates the place of its publication with only the author responsible for the combination cited. This is in accordance with Art. 72, ICBN where it is stated that an author may use an epithet previously used in an illegitimate name, but the epithet in the resulting combination is treated as new.

#### *Representative and cited specimens examined* (c. 144 specimens seen)

NEW SOUTH WALES: *Beckler s.n.*, s. dat. Hastings River (MEL 86963); *Coveny 8993 & Roy*, 23.xi.1976, Waa Gorge, Mt Kaputar National Park (68 km NE of Narrabri (NSW); *Jessup & Gray 2526*, 16.ii.1954, Mingoola Dam Site, Severn R, 40 m W of Tenterfield (CANB); *Solling 516*, 5.x.1972, 1 m N of Turrawan on Narrabri-Boggabri Rd (NSW); *Streimann 802*, 14.xii.1973, Cox Gap, 34 km WSW of Denman (CBG); *Wilson 1304*, 28.iii.1975, "Iolanthe", 26 km W of Garah (NSW).

NORTHERN TERRITORY: *R.M. Barker 357*, 29.iv.1983, Middle Creek, on road to Douglas Daly Research Farm (AD); *Byrnes 1254*, 19.ii.1968, Elizabeth River (DNA, NT — 2 sheets); *Byrnes 1301*, 22.i.1969, 10 m E Adelaide River Bridge (DNA, NT — 2 sheets); *Dunlop 3411*, 2.iii.1973, E Alligator River (NT, DNA); *McKean B841*, 28.xii.1972, Howard Springs (NT, DNA); *Rankin 1557*, 8.xi.1978, Horn's Creek area (DNA).

QUEENSLAND: *Bailey 89*, vi.1897, Thursday Island (BRI); *Biddulph s.n.*, 1890, Mt Playfair (MEL 1516464, MEL 101284, MEL 100697); *Brown s.n.*, 10.viii.1802, Keppel Bay and viii-ix.1802, Thirsty Sound (BM: p.p. — 2 sheets, see Typification and Note 2); *Byrnes 3585 & Clarkson*, 4.iv.1978, 26 km N of Marlborough (BRI); *Byrnes 3947*, xii.1978, Mt Ommaney, Brisbane (BRI); *Everist & Webb 1219*, 20.xi.1946, Westbrook-Pittsworth Rd (BRI, CANB); *Henderson 187*, 26.ii.1967, area surrounding State Wheat Board installations, Moura (BRI); *Hubbard & Winders 6756*, 22.i.1931, Chillagoe (BRI, K); *Looker s.n.*, s. dat. Ballandool River (MEL 86952, K); *Purdie & Boyland 254*, 26.iii.1976, 24 km from Charleville on road to Quilpie (BRI); *Specht & Salt W 199*, 9.xii.1974, 23.5 km ENE of Weipa Mission (BRI); *Walter s.n.*, s. dat. No. 2 Island, Percy Group (MEL 86937).

WESTERN AUSTRALIA: *Kenneally* 7959, 25.i.1982, Remote weather station, 29 km N of mining camp, Mitchell Plateau (PERTH); *Kenneally* 8623, 4.xii.1982, 6 km N of mining camp site on track to Port Warrender, Mitchell Plateau (PERTH).

### Specimens intermediate between *B. pumilio* and *B. australis*

NEW SOUTH WALES: *Telford* 5031 & *Butler*, 25.x.1976, c. 40 km NNE of Lithgow, 1.5 km SSW of Glen Davis. Green Gully (CBG); *Campbell* s.n., 27.xii.1940, Bonshaw (NSW 148561).

QUEENSLAND: *Lau* 80, 1866, Darling Downs (MEL); *Francis* s.n., ix.1925, Dalby (BRI); *Hartmann* 67, s. dat., Severn (MEL); *Mounday* s.n., s. dat., Jimbour (BRI); *Roe* A 17, 20.ix.1973, Warrie, Moonie R. (CANB); *Webb* 393, s. dat. Yeppoon Rd, E of Rockhampton (BRIU 3270).

6. ***Brunoniella pumilio*** (R. Br.) Bremek., Proc. Kon. Ned. Akad. Wetensch., Ser. C, 67 (1964) 305; Jacobs & Pickard, Pl. N.S. Wales (1981) 61; Beadle, Evans & Carolin, Fl. Sydney Reg. (1982) 506; — *Ruellia pumilio* R. Br., Prodr. (1810) 479; Lindau in Engler & Prantl, Nat. Pflanzenfam. IV, 3b (1895) 311. — *Dipteracanthus pumilio* (R. Br.) Nees in A. DC., Prodr. 11 (1847) 124; F. Muell., Votes & Proc. Leg. Assemb. N.S. Wales 1858-9, 2 (1859) 8. — *Aporuellia pumilio* (R. Br.) Domin, Biblioth. Bot. 89 (1929) 650 (at least as to *Brown* 2944, other specimens n.v.).

*Lectotype* here designated: *R. Brown* 2944, 8.vi.1802, Port Jackson (BM); *isolectotype*: (BM, K).

*Ruellia australis* var. *pumila* Benth., Fl. Austral. 4 (1868) 547, p.p. (only as to Brown's collections from Port Jackson with glabrous and narrowly ovate calyx lobes and partly *Lau* 80) — *Dipteracanthus australis* (R. Br.) Hassk. var. *pumila* (Benth.) Jacobs & Pickard, Pl. N.S. Wales (1981) 61: pro syn. For typification see *Brunoniella australis*.

*Ruellia australis* auct. non Cav.: Cav., Icon 6 (1801) 62, p.p. (only as to left hand side specimen of *isolectotype* sheet, *Née* 46).

Small sprawling herb, to 10 cm high, branches more or less glabrous, often somewhat flattened, usually with longitudinal furrows. *Leaves* of opposite pairs more or less equal; petioles 1-4 mm long, blade elliptic to obovate, 0.5-1.5 x 0.3-1.2 cm, narrow- to broad-cuneate at base, entire to slightly crenulate, obtuse apically, upper surface dark green, small linear cystoliths sometimes visible, glabrous, lower surface pale green, glabrous. *Inflorescence* solitary or, more commonly, paired, more or less sessile or shortly pedicellate, flowers in distant axils (lowest nodes 1.5-5.5 cm apart), combined into a terminal spikelike raceme or thyrs. *Pedicel* (measured to base of bracteole) 2-10 mm long, glabrous. *Bracteoles* narrowly ovate to lanceolate, 3.5-5 x 1.1-1.8 mm, green, glabrous or with sparse, very short hairs (not visible to naked eye) sometimes confined to very narrow white margin, sometimes all over. *Calyx* lobes narrowly ovate to lanceolate, 7-16 x 1-2.8 mm, indumentum similar to bracteoles. *Corolla* blue or mauve, externally eglandular hairy, internally glabrous except for eglandular hairs on basal half of throat; tube 3-3.5 mm; throat 6-7.8 mm; lobes 5-10.5 mm. *Stamens* 4, rarely (*Phillips* CBG 024708) with single staminode in form of filament lacking anthers; filaments c. 2-2.5 mm long, hairy at base; anthers 1.4-1.7 mm long, connective not produced past cells. *Ovary* glabrous, 5 superposed ovules per cell; style 6.4-6.5 mm long, eglandular hairy in upper half; stigma with 2 unequal lobes. *Capsule* 12.5-17.5 mm long. *Seed* and hooks not seen. Fig. 11E, F.

### Typification

The lectotype sheet bears a note by C.B. Clarke that this is "not *Ruellia australis* var. *pumilio* or *pumila* of Benth". In this statement Clarke was correct as Benth's var. *pumila* consists of a mixture of *B. australis* and *B. pumilio*, only the Lau and Brown collections being referable to *B. pumilio*.

### Distribution

*B. pumilio* is known chiefly from coastal New South Wales, with two collections from Mallacoota Inlet in Victoria and a number of specimens from the Darling Downs in Queensland which show an approach to this species (see *B. australis*, Note 4). Fig. 15.

### Ecology

From the few ecological annotations available, the species is often found in coastal sandstone areas regenerating after fire. All specimens have flowers and were collected between October and April, with the exception of the type which was gathered on June 8th.

### Notes

1. This species is generally readily distinguished by its ovate calyx segments (Fig. 11E). The calyx segments of *B. australis*, with which this species has sometimes been confused, differ in their shape (lobes linear) and indumentum. Only *B. acaulis* ssp. *ciliata* approaches the calyx of *B. pumilio*, but it differs from *B. pumilio* in its prostrate habit and the lax hairs found throughout the interior of the corolla throat.

2. For specimens intermediate between *B. pumilio* and *B. australis* see under *B. australis* (Note 4 and specimens examined).

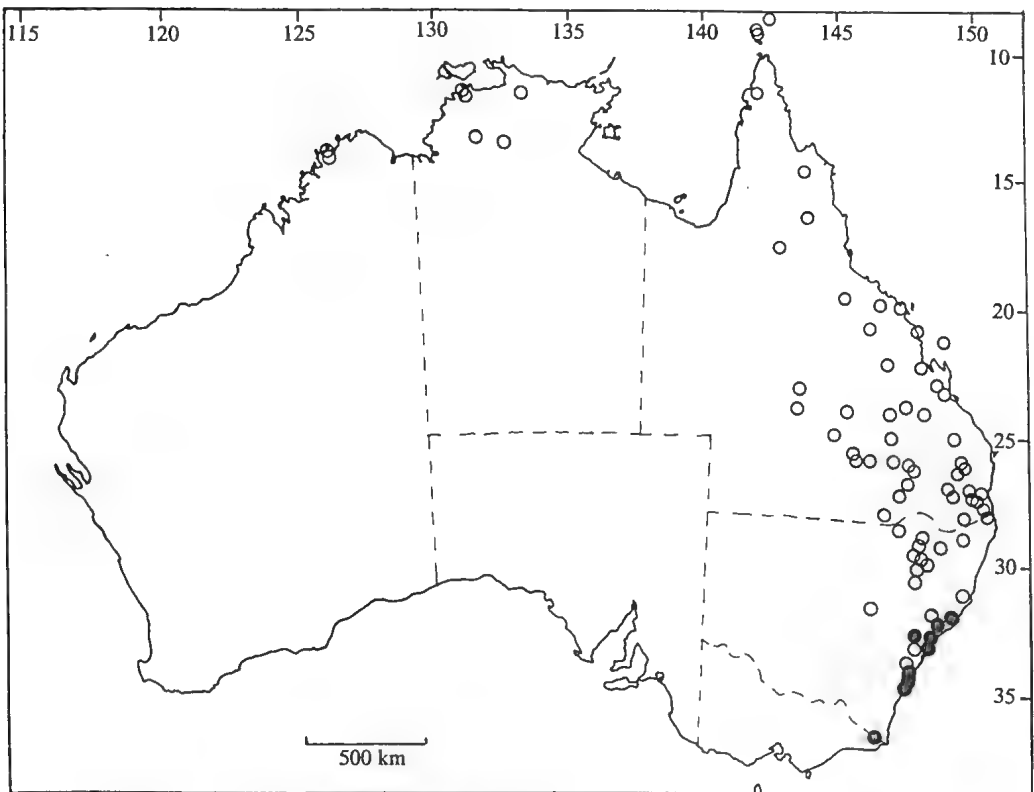


Fig. 15. Distribution of ○ *Brunoniella australis* and ● *B. pumilio*.

*Specimens examined*

NEW SOUTH WALES: *Anon. (the teacher) s.n.*, ii.1910, Medowie (10 m NE of Raymond Tce) (NSW 148574); *Bäuerlen 450*, iii.1884, Shoalhaven (MEL); *Bauerlen 634*, ix.1884, Shoalhaven (MEL); *Brown 2944*, 8.vi.1802, Port Jackson (BM — 2 sheets); *Cambage 2151*, 22.xii.1958, Milton (NSW); *Camfield s.n.*, iii.1896, Hurstville (NSW 148586 p.p.); *Camfield s.n.*, 15.vi.1901, Carleton (NSW 151824); *Camfield s.n.*, 2.iv.1902, Hurstville (NSW 148579); *Camfield s.n.*, 1893, Kogarah (NSW 148578); *Camfield s.n.*, xi.1892, Oatley (NSW 148577); *Cleland s.n.*, 18.iii.1912, Rookwood (Sydney suburb) (AD 96307248); *Constable s.n.*, 18.i.1952 Bulahdelah-Lake Myall (NSW 19063, K); *Coveny 5351*, 30.xi.1973, 3.2 km SW of Casula (NSW, K); *Davis 1*, iv.1913, West Martland (NSW 148573); *Fletcher s.n.*, 29.i.1887, Field of Mars (Gladesville) (NSW 148568); *Francis s.n.*, iv.1913, Woy Woy (NSW 148571); *Fraser s.n.*, xi.1933, Pennant Hill (NSW 148569); *Heron s.n.*, xi.1898, Congola (NSW 148562); *Ingwerson 12*, 13.ii.1973, Jervis Bay (CBG); *Johnsen s.n.*, 14.xi.1965, 1 m N of Gibba Swamp, Colo-Pulty Rd (NSW 148570); *Mather s.n.*, iii.1938, Newcastle (NSW 148572); *Phillips s.n.*, 7.iii.1961, Nr St Georges Basin Golf course site on road to Jervis Bay (CBG 024708); *Rodway 6737*, 23.iii.1929, Huskisson, Jervis Bay (NSW 148563, 148564); *Rodway 6741*, 11.iii.1934, Jerrawangala, 4 m S of Wandaianindian (NSW); *Rodway 6740*, 31.x.1930, Junction of Braidwood and Yalwal Rds, Nowra (NSW 148565); *Rodway 6739*, 28.i.1933, Flat Rock Ck, Nowra (NSW 148566); *Rodway 11761*, 1.i.1941, South Crook Haven, South Coast (NSW 148567); *Rupp B.*, x.1915, Chiswick, Paramatta R. (MEL 86936); *Rupp s.n.*, iv.1923, Bulladelah (MEL 86968); *Stuart 2*, 1877, Paramatta (MEL); *Wrigley s.n.*, 19.iii.1969, 8 m S of Bulahdelah at Nerang Ck (CBG 028827).

VICTORIA: *Beaglehole s.n.*, 24.x.1970, Mallacoota Inlet National Park, 1/3 m by road from park sign Mallacoota-Genoa Rd (MEL 522364); *Beaglehole s.n.*, 26.x.1970, Mallacoota Rd, more or less 8½ m S of Genoa (NSW 148576).

AUSTRALIA WITHOUT LOCALITY: *A. Cunningham or Anderson et al s.n.*, s. dat. (MEL 583975).

## 9. HEMIGRAPHIS Nees

Two Queensland collections represent the first record of *Hemigraphis* for Australia. The collections seem to be most closely allied to a southern New Guinea species, but types have yet to be consulted and New Guinea *Hemigraphis* is in much need of revision.

**Hemigraphis** Nees in A. DC., Prodr. 11 (1847) 722; Bremek., Verh. Kon. Nederl. Akad. Wetensch., Afd. Natuurk. 41 (1944) 74; Bremek., Nova Guinea n.s. 8 (1957) 132.

*Type species: H. latebrosa* (Heyne ex Roth) Nees (India), lectotype (Bremekamp 1944) but not designated in Index Nominorum Genericorum (Bullock 1979): see Typification.

*Ruellia* auct. non L.: Nees in Wall., Pl. Asiat. Rar. 3 (1832) 82 p.p. (excluding spp. 4 and 6 according to Bremekamp 1944); Nees in A. DC., Prodr. 11 (1847) 145 p.p. (excluding spp. 11-15 and 24 according to Bremekamp 1944).

Herbs with cystoliths. *Leaves* petiolate, entire or incised, opposite pairs connected by transverse ridge. *Inflorescence* a terminal or axillary spike composed of single flowers in axils of overlapping bracts. *Bracteoles* present or not at base of calyx. *Calyx* segments 5, free almost to base, equal or unequal. *Corolla* tube widening into throat, internally hairy on adaxial side, lobes 5, more or less equal. *Stamens* 4, inserted at base of corolla throat, didynamous, included in throat; filaments connected basally by membrane, pubescent or glabrous; anthers medifixed, 2-celled; cells parallel, equal, without appendages. *Disc* unknown. *Ovary* cells with 4-6 ovules in two vertical rows; stigma with 2 unequally subulate lobes, more or less glabrous. *Capsule* cylindrical, with seeds throughout length, seed-bearing hooks conspicuous. *Seed* 6-12, discoid, hairs all over, expanding on contact with water. Fig. 8 I-J.

*Typification*

In his original publication of the genus Nees (1847a) described 2 species, *H. latebrosa* and *H. elegans*. Bremekamp (1944) nominated the former as the type of the genus and this was repeated in his typification of the genus for ING (1955). Although he gave no justification for this decision, it possibly arose because he recognised *H. elegans* as illegitimate and considered it should be replaced by the earlier epithet 'crossandra'. In compiling type species for Index Nominorum Genericorum, Bullock presumably overlooked this designation by Bremekamp.



### Distribution

Earlier works (Clarke 1885, Lindau 1897) attributed 20 species to the genus and limited its distribution to tropical Asia. Bremekamp's (1944) treatment, however, recognises 61 species from Malesia with a further 8 described subsequently (Bremekamp 1957) from New Guinea. The species in the genus spread from India and China through to New Guinea, with a single species in Australia.

**Hemigraphis cf. royenii** Bremek., Nova Guinea n.s. 8 (1957) 132.

**Holotype:** *van Royen 4770*, between Wam River and Lake Wam, alt. 60 m, Merauke District (L: n.v.).

Decumbent herb, branches 4-angled and -grooved, sometimes constricted above each node, eglandular hairy. *Leaves* with petioles eglandular hairy, 0.5-2 cm long; blade elliptic, 3-9.7 x 2-4 cm, attenuate at base, shallowly crenate, acuminate or acute at apex, upper surface more or less shiny, glabrous, lower surface glabrous apart from few sparse eglandular hairs on main veins and margins of lower surface. *Inflorescence* c. 1-3 cm long, a condensed terminal spike of verticillately arranged bracts, each bract enclosing a single flower. *Bracts* leaf-like, more or less sessile, lanceolate, 9.5-16.5 x 2-4 mm, both surfaces with short eglandular hairs, longer, more robust eglandular hairs on margins easily visible. *Bracteoles* absent. *Calyx* segments linear, more or less equal, 7-8 x 0.8-0.9 mm, externally with eglandular hairs more robust and longer on margins and apex of lobes, internally with very fine appressed eglandular hairs. *Corolla* (one mature flower seen) white, veined with purple, c. 15 mm long, tube and throat c. 10-11 mm long, externally with very fine hairs on throat, lobes? and tube glabrous. *Stamens* with abaxial filaments c. 1.8 mm long, a line of dense, erect, long hairs throughout their length, adaxial filaments c. 0.8-1.0 mm long, a few less rigid hairs throughout their length; anther cells linear, c. 1.3 mm long. *Ovary* with 4 ovules per cell, distinctly hairy in apical half; style eglandular hairy throughout, c. 6 mm long; longer (? adaxial) stigmatic lobe 0.6 mm long, ? sparsely pubescent on inner surface. *Capsule* 8-9 mm long, eglandular hairy in apical half, with 4 seeds and seed-bearing hooks per valve. *Seed* c. 1.5 mm diameter, shortly mucronate at apex. Fig. 8 I, J.

### Distribution

Only two collections of this species have been made in Australia so far, and both are from the Iron Range area of Cape York Peninsula. Fig. 16.

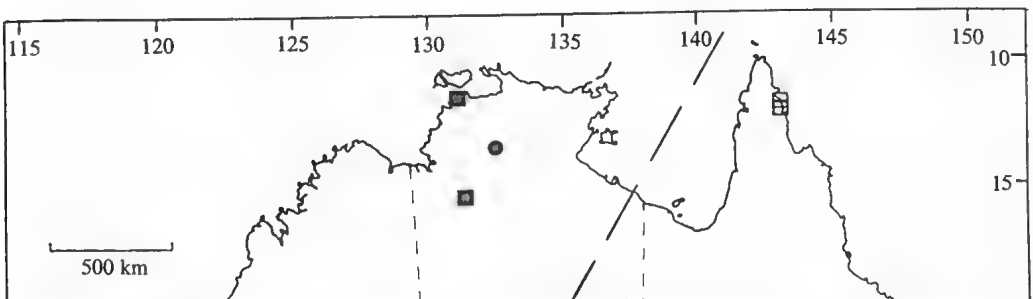


Fig. 16. Distribution of *Barleria* and *Hemigraphis* in Australia (■ *Barleria prionitis*; ● *B. lupulina*; □ *Hemigraphis* cf. *royenii*).

### Ecology

Annotations on specimens are "undergrowth of dryish rainforest of ridges" (*Brass 19147*) and "semi evergreen vine forest on alluvial soils derived from a mixture of acid and basic rocks" (*Webb & Tracey 8535*). The *Brass* collection is in the early stages of flowering while the *Webb* and *Tracey* collection has mature capsules with seed. From this it can be inferred that flowering occurs between June and October.

### Note

Because of possession of hairs for the whole length of the filaments, the upright habit and condensed spikes, the Australian species belongs to Bremekamp's series *Pubicrures* (Bremekamp 1944). In neighbouring New Guinea, the series is represented by three species, *H. whitei* S. Moore, *H. ciliata* S. Moore and *H. royenii* Bremek., and a comparison of characters (taken from Moore 1920 and Bremekamp 1957) is given in Table 12. Although no type material of the three species has been seen, the Australian specimens seem very close to *H. royenii* Bremek. However, a thorough review of the Malesian species (c. 70 species) is required. All *Hemigraphis* holdings of LAE and MEL have been seen, but most of the collections are unnamed at species level, even though some have been seen by Bremekamp, the most recent worker in the genus. More material of the Australian species is required to establish its variation pattern, and confirm and expand floral characteristics given in the description.

### Specimens examined

QUEENSLAND: *Brass 19147*, 12.vi.1948, Iron Range (BRI, L); *Webb & Tracey 8535*, 21.x.1968, Claudie River between Portland Roads and Iron Range (BRI).

Character	<i>H. whitei</i> S. Moore	<i>H. ciliata</i> S. Moore	<i>H. royenii</i> Bremek.	Australian <i>Hemigraphis</i>
petiole length	2 mm	5 mm	4-15 mm	5-20 mm
leaf dimensions	1.5-1.8 x 1 cm	3.5-6 x 1-2.3 cm	2.5 x 1.4 cm lower 3.7-9.2 x 1.2-2 cm upper	3-9.7 x 2-4 cm
peduncle	—	2 mm	10 mm	3-7 mm
spike	3-4 cm	1-1.5 cm	3-4 cm	1-3 cm
bract dimensions	14 x 7 mm	10 mm long	13-16 x 4.5-6 mm	9.5-16.5 x 2-4 mm
bracteoles	none	none	none	none
calyx length	6-7 mm	6 mm	6-8 mm	7-13.5 mm
corolla length	10 mm	78 mm	15 mm	15 mm
ovary	—	—	upper half hairy	upper half hairy
style length	8 mm	—	8 mm	6 mm
style indumentum	hairy	—	hirtellous	hairy
capsule length	7 mm	7.5 mm	9 mm	8-9 mm
capsule indumentum	apically hairy	apically hairy	upper half hairy	apically hairy
number of seeds per capsule	6	6	8	6-12

Table 12: Comparison of characters of *Hemigraphis* ser. *Pubicrures* species from New Guinea with Australian material.

10. **HYGROPHILA** R. Br.

Australian material of *Hygrophila* was described by Robert Brown (1810) as *H. angustifolia* when he first described the genus. This was accepted in both the major works of Nees von Esenbeck (1832, 1847a) where a large number of species were described for the genus, many of them having been transferred from *Ruellia* (see Table 13). Subsequently, Anderson (1867) united nine of the *Hygrophila* species described by Nees from Asia including *H. angustifolia* R. Br. into one "common species of aquatic weed extending over many degrees of latitude". These were all united under the name *H. salicifolia*, the basionym for which was *Ruellia salicifolia*, described by Vahl in 1794 (Table 13). Within it, Anderson recognised two varieties, var. *glabra* (encompassing *H. quadrivalvis*, *H. undulata*, *H. radicans* and *H. angustifolia*) and var. *hirsuta* (including *Ruellia hirsuta*, *H. phlomoides*, *H. incana* and *H. assurgens*).

Bentham (1868) in 'Flora Australiensis' followed Anderson's concepts in ascribing the Australian material to *H. salicifolia*, "a common Asiatic species". Since then Australian works have used either *salicifolia* or *angustifolia* as the epithet, with the exception of Domin (1929) who followed Kuntze (1891) in referring *H. angustifolia* to a variety of *H. salicifolia*. However Kuntze's original transfer of *H. angustifolia* to a variety of *H. salicifolia* was related to specimens from Trinidad not Australia.

Basionym	Author	Date of Publication	Region
<i>Ruellia ringens</i>	Linnaeus	1753	India
<i>Ruellia erecta</i>	Burm.f.	1768	India
<i>Ruellia undulata</i> <i>Ruellia salicifolia</i> <i>Ruellia barbata</i>	Vahl	1794	India
<i>Hygrophila angustifolia</i>			
<i>R. hirsuta</i> <i>R. obovata</i>			
<i>H. quadrivalvis*</i> , nom. illeg.	Hamilton or Wallich ex Nees	1832	India, Ceylon & Philippines
<i>H. radicans</i>	Wallich ex Nees	1832	India
<i>H. phlomoides</i>	Wallich ex Nees	1832	India
<i>H. incana</i>	Nees	1847	India
<i>H. assurgens</i>	Nees	1847	Java, China, India, Philippines

\*According to Nees in the protologue also including *R. barbata* Vahl, which not only makes *H. quadrivalvis* illegitimate, but also would give *R. barbata* priority. Clarke (1885) considers *R. barbata* does not belong here and Bremekamp (1948) assigns it to *H. erecta*.

Table 13: Early specific epithets applicable to *Hygrophila*

**Hygrophila** R. Br., Prodr. (1810) 479; Nees in Wallich, Pl. Asiat. Rar. 3 (1832) 80; Nees in A. DC., Prodr. 11 (1847) 85; Benth. in Benth. & Hook. f., Gen. Pl. 2 (1876) 1075; Lindau in Engl. & Prantl, Nat. Pflanzenfam. IV, 3b (1895) 296.

*Type species.* *H. angustifolia* (Australia).

Erect herbs with cystoliths. *Leaves* and sometimes flower subtending bracts petiolate or sessile, opposite pairs connected by transverse ridges. *Inflorescence* 2-many sessile flowers in axillary whorls resembling a leafy spike, or flowers pedicellate and inflorescence racemose.

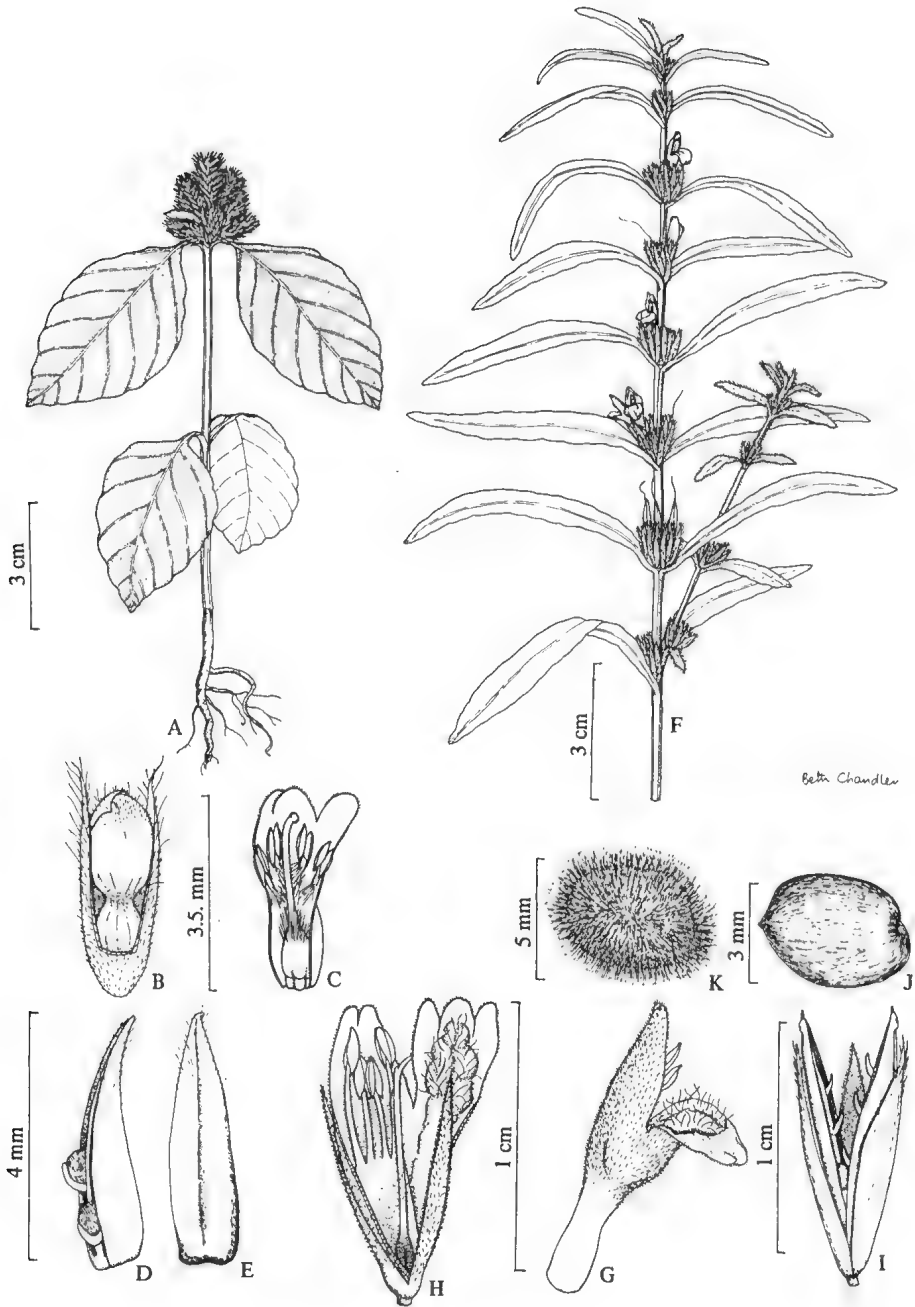


Fig. 17. A-E, *Lepidagathis* cf. *royenii* Bremek. A, habit; B, single flower, calyx partly removed to show corolla tube constriction; C, opened bud; D, capsule (lateral view) showing seed-bearing hooks with seeds; E, capsule, ventral views (Clarkson 3602). F-K, *Hygrophila angustifolia* R. Br. F, habit (Craven 4628); G, flower, lateral view; H, opened to show insertion of stamens (R.M. Barker 427); I, partially opened capsule still enclosed by calyx; J, dry seed; K, wet seed with expanded mucilaginous hairs (Martensz 175).

*Bracteoles* small (in Australia), usually shorter than calyx. *Calyx* of 5-equal segments, free or fused at base. *Corolla* tubular at base, widened above into throat; limb 2-lipped; upper lip porrect, convex, shortly 2-lobed; lower lip 3-lobed, recurved (in Australia) or porrect, with hairy palate. *Stamens* 4, didynamous, inserted in throat, fused together at base by basal membrane, exerted from throat; anther cells 2, parallel, inserted at equal level, not awned. *Ovary* ellipsoid, each cell with 4-20 or more ovules in two vertical rows; style slender; stigma entire or unequally 2-lobed. *Capsule* fusiform, bearing seeds throughout length; seed-bearing hooks prominent, or (in introduced species) minute, conical and not curved. *Seeds* 8-many, covered with long mucous hairs, appressed when dry, rapidly expanding and spreading on wetting. Fig. 17 F-K.

### Distribution

*Hygrophila* probably consists of only 20-30 species distributed throughout the tropical and subtropical regions of the world. In Australia there is one native species from northern Australia and a second naturalized species from the Northern Territory.

### Note

Relationships and choice of name of the Australian native species

The decision had to be made which of the epithets 'angustifolia' or 'salicifolia' best applies to the native species of *Hygrophila*. To do this it was necessary to look within Malesian material assigned to *H. salicifolia* and *H. erecta*.

Within Malesia, Hochreutiner in 1934 transferred *Ruellia erecta* Burm. f. (Table 13) to *Hygrophila*. Bremekamp (1948) also recognized *H. erecta* (Burm. f.) Hochr. (synonyms *H. undulata*, *H. obovata*, *H. quadrivalvis* and *Ruellia barbata*) as well as *H. salicifolia* (Vahl) Nees (synonym *H. angustifolia*). However Backer (1965) in 'Flora of Java' made the comment that *H. salicifolia* is "not sharply separated from [*H. erecta* and] possibly only one of the many forms of it".

Having seen material of both species, I consider that the level of difference between these two taxa would be more appropriately expressed at the infraspecific level. The only reliable difference between *H. salicifolia* and *H. erecta* appears to be in the leaf shape, the latter having usually small, ovate leaves, while the former tends to have longer, lanceolate leaves. Both taxa differ from most Australian specimens in flower size, leaf shape and the number of hooks in the capsule (Table 14). There are, however, a number of specimens including the holotype of *H. angustifolia*, which approach the larger flower size and wider leaves of Asian specimens, but in keeping with the other Australian material, these always have 12 or less hooks per valve of the capsule.

Character	Australian	<i>H. salicifolia</i>	<i>H. erecta</i>
Flower length	7-10 (-15) mm	12-18 mm	14-18 mm
Leaf shape	narrow linear to lanceolate	lanceolate to linear lanceolate	ovate
Leaf length	2-16 cm	3.5-13 cm	1-16 cm
Leaf breadth	0.2-0.8 (-1.4) cm	0.3-2 cm	0.75-5 cm
Hooks/valve	(4-) 8-12	12-20	15-20

Table 14: Comparison of Australian specimens of *Hygrophila* with *H. erecta* and *H. salicifolia* from Malesia.

New Guinea specimens of *Hygrophila* were assigned by Bremekamp (1957) to two species, *H. salicifolia* and *H. phlomoides* Nees. The latter is described as having sessile, oblong-elliptic,

hairy leaves and hirsute calyx segments. Clarke (1885) recognised two new varieties of *H. phlomoides* in India, var. *roxburghii* with flowers c. 12 mm long and var. *repens* with smaller flowers, while var. *phlomoides* was described as having flowers of c. 19 mm length. Some specimens from New Guinea have hairy calyx segments, sometimes hairy leaves, and flowers 10-12 mm long, but only in one case could the leaves be described as oblong-elliptic (*van Royen* 4573). In all other cases the leaves are long, narrow-linear, or lanceolate and approach Australian specimens. They also agree with Australian material with respect to flower size and the number of seed-bearing hooks.

Accordingly it seems best to recognise Australian and New Guinea material as distinct at the specific level. In this case Robert Brown's *H. angustifolia* has priority. Further revisional work on the *H. salicifolia*-*H. erecta* complex in Malesia is required before this can be considered final. Meanwhile, the two may be separated by the following key:-

- 1a. Seed-bearing hooks (4)-8-12 per cell. Flowers 7-10 (-15) mm long. Leaves narrow linear to lanceolate, 2-16 x 0.2-0.8 (-1.4) cm ..... *H. angustifolia*
- 1b. Seed-bearing hooks 12-20 per cell. Flowers 12-18 mm long. Leaves lanceolate, linear-lanceolate or ovate, 1-16 x 0.3-5 cm ..... *H. erecta*-*H. salicifolia*

It should be further noted here that *H. salicifolia* and *H. erecta* are both probably predated by a Linnaean epithet "ringens" (Table 13). Linnaeus described *Ruellia ringens* from India in 1753 and Anderson (1864) considered the specimen to belong to *H. salicifolia* after examination of types in the Linnean herbarium. More support for a name change is given by Robert Brown's (1810) statement when describing *H. angustifolia* that it had affinity ("hujus congener et valde affinis") with '*Ruellia ringens*' of Linnaeus. I have seen a photograph of *Ruellia ringens* in the Linnean herbarium (LINN 804.13: microfiche AD) and this judgement seems likely to prove correct.

The status of *H. phlomoides* also needs to be investigated in relation to the *H. erecta*-*H. salicifolia* complex in Malesia. New Guinea and Australian specimens sometimes have the ciliate calyx segments diagnostic of this species, but the character seems more likely to be a phenotypic expression of drier habitat. Two specimens identified as *H. phlomoides* by Merrill from the Philippines are much more densely hairy all over and have larger flowers than material identified by Bremekamp as *H. phlomoides* in New Guinea. *H. pusilla* Bl. is characterized by 1-3 flowers in the axils, and the recurving of the calyx lobes at anthesis. Some New Guinea collections, *Brass* 5999 and *Brass* 8306, have the recurved calyx lobes but only the latter has a few flowers at each node; this is possibly an age factor. The material seems more like depauperate *H. angustifolia* but this too is in need of investigation. Should it be found to be a 'good' species then some of the Australian material could possibly be referred to it. A revision of the *Hygrophila* species occurring from India through to Malesia should clarify the status of all of the species discussed.

### Key to Australian species of *Hygrophila*

- 1a. Leaves always narrow-linear to lanceolate with entire or undulate margins, glabrous or with appressed eglandular hairs ..... 1. *H. angustifolia*
- 1b. Leaves when submerged, pinnatifid and glabrous, when emergent, ovate, serrate and covered with erect glandular hairs ..... 2. \**H. cf. triflora*

1. *Hygrophila angustifolia* R. Br., Prodr. (1810) 479; Nees in A. DC., Prodr. 11 (1847) 91; F. Muell., Syst. Census Austral. Pl. (1882) 99; F. Muell., Sec. Syst. Census Austral. Pl. (1889) 167; Betche, Proc. Linn. Soc. N.S. Wales 29 (1904) 748; Maiden & Betche, Census N.S. Wales Pl. (1916) 185; Ewart & Davies, Fl. N. Terr. (1917) 251. — *H. salicifolia* (Vahl) Nees var. *angustifolia* (R. Br.) Kuntze, Rev. Gen. Pl. (1891) 491 (based on Trinidad specimens); Domin, Biblioth. Bot. 89 (1929) 602.

*Probable holotype: Banks & Solander N.H. 61, s. dat. Endeavour River (BM).*

*H. salicifolia* auct. non (Vahl) Nees: T. Anders., J. Linn. Soc. Bot. 9 (1867) 456, p.p. (with respect to Australian mention); Benth., Fl. Austral. 4 (1868) 545; F.M. Bailey, Fl. Qld 4 (1901) 1143; F.M. Bailey, Compr. Cat. Qld Pl. (1913) 368; Gardner, Enum. Pl. Austral. Occid. (1930) 119; J. Beard, W. Austral. Pl. 2nd edn (1970) 119; J. Green, Census Vasc. Pl. W. Austral. (1981) 95.

Erect herb, becoming decumbent with age, (16)-50-100 (-180) cm high. *Branches* glabrous, or with sparse eglandular hairs, usually 4-angled, often ribbed, thickened at nodes. *Leaves* subsessile, long-linear to lanceolate, 2-16 x 0.2-0.8 (-1.4) cm, gradually attenuate at base, entire or undulate, obtuse at apex, more or less glabrous, or with sparse or more rarely moderately dense eglandular hairs on one or both surfaces. *Inflorescence* sessile axillary clusters or pseudo-whorls of 2-c. 12 flowers in axils of most leaf pairs. *Bracteoles* ovate, 2.2-8.2 mm long, shorter than calyx, glabrous with margin setaceous. *Calyx* 8.5-11 mm long, segments joined for over half their length, more or less glabrous (possibly appearing hairy because of dense cystoliths), or with glandular hairs alone or these sometimes mixed with eglandular appressed hairs, or with eglandular hairs alone on outer surface. *Corolla* purple, blue, mauve or more usually white with darker markings, ? rarely (Note 1) yellow; tube and throat combined 6.5-7 (-8.5) mm long, tube externally glabrous; lobes 3 (-5.5) mm long, lobes and throat externally with mixture of glandular and eglandular hairs, internally glabrous except for 2 lines of hairs along outer edge of basal membrane which connects base of stamens in tube. *Stamens*: filaments glabrous; abaxial pair c. 3 mm long, adaxial pair c. 2 mm long. *Ovary* glabrous; style 5-6 mm long, curved in bud, with glandular or eglandular hairs or both along entire length; stigma with 2 thickenings at base of down-curved, subulate extension, same height as 2 abaxial stamens when receptive. *Capsule* 10-14 mm long, glabrous, apex with 2 round swellings on either side (these probably hygrochasic: see p. 22); seed-bearing hooks 4-12 per cell. *Seed* discoid, sometimes angled, 10-15 mm diameter, covered with fine mucilaginous hairs which may not be obvious in dry state. Fig. 17 F-K.

### Typification

The Banks & Solander collection in BM has been seen, but it is not known whether there are duplicates of this collection in other herbaria and so it can only be designated as the probable holotype. It should be noted that this material is one of the specimens which approaches *H. salicifolia*-*H. erecta* in its flower size.

### Distribution

*H. angustifolia* is found throughout northern tropical Australia and extends down the eastern coast as far as Casino in New South Wales. It also occurs in New Guinea. Fig. 18.

### Ecology

*H. angustifolia* is a common species with "weedy" characteristics. It is always found in wet places, particularly those associated with swamps, bogs and river or creek banks. It does not apparently suffer when inundated as several collections are from shallow water on the edges of swamps where it also extends onto the cracking clay margin. Other localities include the grass verge of an airstrip, paperbark forest and the *Pandanus* fringe of sub-coastal plains. It often seems to be associated with black loam or at least black soil plains.

Flowering specimens have most commonly been collected in the months from April to August.

References to the palatability of *H. angustifolia* range from a suspicion of its poisoning cattle (Thomas BRI 039882) to a statement that it is often eaten (Cameron 2143). Observation of the species in the Northern Territory would confirm this latter statement, the chief grazers being cattle.

## Notes

1. The reference to a yellow flower colour by Dallachy (Bentham 1868) is possibly erroneous and may have arisen because the dried flower is yellowish in colour. A similar reason may also apply to Betcher's (1904) statement where in first recording the species for New South Wales, he also reported the flowers yellow.

2. Most Australian specimens of *Hygrophila* lack glandular hairs, the exception being a group of specimens, mainly from Arnhem Land (e.g. *Martensz AE 175*, *Craven 4469*) and a few from Queensland (e.g. *Pullen 9006*, *Cameron 2143*) which have glandular hairs on the calyx. These vary in extent of cover of glandular hairs from almost none to moderately dense and appear to have no other distinguishing feature. The collection *Holtze 437* has glandular hairs extending on to the bracts and occasionally on to the young leaves. These collections are maintained under *H. angustifolia*; formal infraspecific separation seems inappropriate at this stage.

*Representative specimens examined* (c. 88 specimens seen).

NEW SOUTH WALES: *Betche s.n.*, iv.1896, Casino (MEL 100769).

NORTHERN TERRITORY: *R.M. Barker 207*, 21.iv.1983, Armstrong River, 8 km S of Top Springs on road to Wave Hill (AD); *R.M. Barker 554 & K. Wilson*, 11.v.1983, Tanumbirini Stn, small creek 21.2 km along No. 9 yards road (AD); *R.M. Barker 560*, 11.v.1983, Caranbirina Waterhole, 70 km E of Cape Crawford on Carpentaria Highway (AD); *Craven 4469*, 28.vi.1977, swamp below Howard Springs (CANB); *Craven 5487*, 15.v.1980, Malabanbandjii Swamp, 10 km E of Nourlangie Ranger Stn on Pine Ck Rd (CANB); *Latz 3532*, 15.x.1972, Wessel Islands (NT); *Martensz AE 175*, 21.vii.1972, Munmarlary Rd, 8 m from Mudginbarry Rd (DNA, CANB, NT); *Mueller s.n.*, v.1856, Baines Creek (MEL 100785); *Nicholls 49*, iv.1967, Tortilla Flats (NT); *Rankin 2263*, 17.iv.1980, Adelaide River flood plain, Arnhem Hwy (DNA).

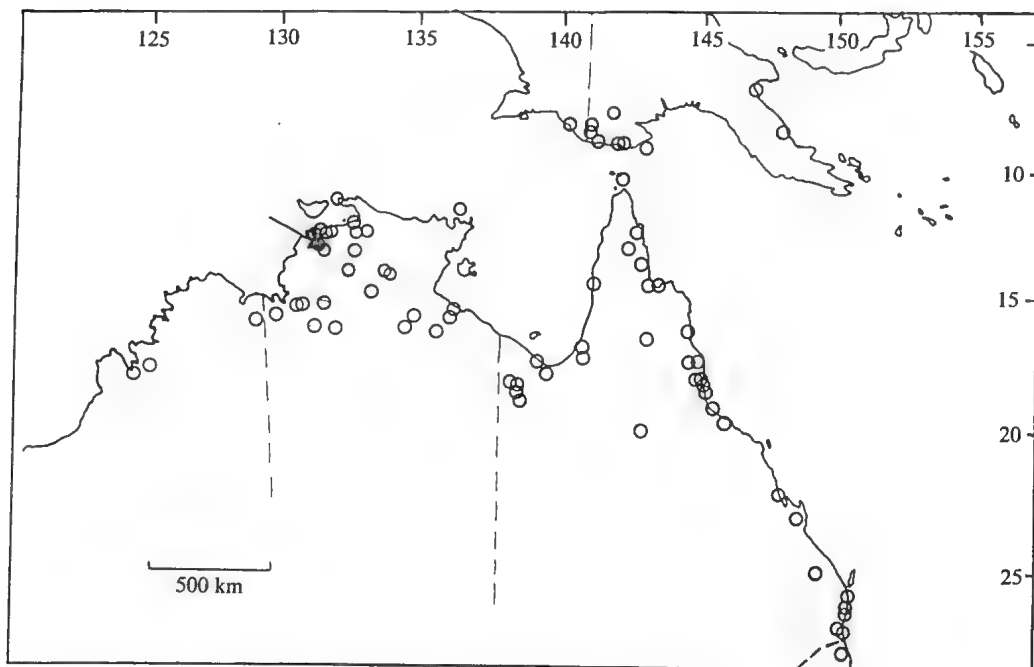


Fig. 18. Distribution of *Hygrophila* in Australia (○ *H. angustifolia*; ▲ *H. triflora*).



QUEENSLAND: *Blake 3233*, 10.ii.1932, W of Petrie, 18 m N of Brisbane (BRI, K); *Brass 19222*, 17.vii.1948, Iron Range (BRI); *Brass 19704*, 27.vii.1948, Wenlock, Batavia R. (BRI, K, CANB); *Cameron 2143*, 25.vii.1975, Horn Island (QRS); *de Lestang 36*, 8.iv.1945, Adel's Grove (QRS); *Jacks s.n.*, 16.vi.1976, 21 m W of Charters Towers (BRIU); *Kershaw & James ANU 10116*, 20.viii.1970, Bromfield's Swamp, Atherton Tableland (CANB — 2 sheets, QRS); *Pullen 9006*, 1.v.1974, String of lagoons S of the Shell Ridge, N part of Wernadinga Stn, Burke District (CANB); *Trapnell 43*, 1.vii.1960, Murray R, Bruce Hwy (BRI); *K. Wilson 5568 & Scarlett*, 20.v.1983, Harris Lake, 9 km SE of Burketown (AD).

WESTERN AUSTRALIA: *R.M. Barker 303*, 26.iv.1983, Granite Ck on Parker Rd into Lake Argyle — 11.7 km from Great Northern Hwy (AD); *Ewart s.n.*, iv.1927, 3 m S of Fitzroy River (PERTH); *Fitzgerald 461*, v.1905, May River near Poulton's Yard (PERTH).

## Non-Australian species of *Hygrophila* examined

### 1. *H. angustifolia*

PAPUA NEW GUINEA: *Darbyshire & Hoogland 8087*, 7.viii.1961, near Sumo Village (on Rhainbrum River), Sepik District (LAE); *Hoogland 3390*, 21.vii.1953, E shore of Lake Koena, Papua (LAE); *Henty & Katik NGF 38654*, 10.vii.1968, Arufi, Wassi Kussa River, Western District, Papua (LAE); *Pullen 7041*, 12.viii.1967, Morehead River, c. 8 miles inland at Long. 141° 30' (K, LAE); *Pullen 7059*, 14.viii.1967, as for *Pullen 7041* (K, LAE); *Paijmans 249*, 15.viii.1967, between Morehead and Bensbach Rivers, Papua (LAE); *Ridsdale NGF 33700*, 13.viii.1967, near Weam, Western District, Papua (LAE); *Sireimann LAE 51707*, 5.viii.1971, Daru Island, Papua (LAE); *Vinas & Maoni KM 015*, 18.ix.1979, Tambari Plain, Balamuk, Bensbach area (LAE); *Womersley NGF 4624*, 9.x.1952, Lae (LAE, NSW). IRIAN JAYA: *van Royen 4573*, 4.viii.1954, road from Mopa to Taram River, south of Merauke, in swamps behind the recent dunes off Borim (LAE).

### 2. *H. pusilla*

PAPUA NEW GUINEA: *Brass 5999*, Dagwa, Oriomo River (K); *Brass 8306*, xi.1936, Gaima, Lower Fly River (K, LAE).

### 3. *H. erecta*-*H. salicifolia*

BORNEO: *Korthals s.n.*, s. dat. [Bandjarmasin] (L: 2 sheets).

INDIA: *Thomson s.n.*, s. dat. Maisor & Carnatic. & *Stocks s.n.*, s. dat. Concan etc. (L).

JAVA: *Anon. [..rlh] s.n.*, s. dat. Bogor (L); *Backer 36893*, 12.ix.1930, Parveroean (L); *Bakhuizen 2012*, 6.vii.1919, Kota Batoe, Buitenzorg (L); *Bakhuizen 5916*, 10.vi.1923, Leurviliang (L); *Blume s.n.*, s. dat. (L); *Raap 431*, 14.vi.1899 (L).

PHILIPPINES: *Clemens 9407*, 25.xii.1915, Parang, Cotabato District, Mindanao (NSW); *Copeland 356*, iii.1904, Davao, Mindanao (NSW); *Elmer 5580*, ii.1904, Bauang, Luzon (NSW); *Elmer 14348*, x.1915, Mt Bulusan, Luzon (NSW); *Merrill (Species Blancoanae 166)*, xi.1914, Antipolo, Rizal Province, Luzon (L, NSW); *Merrill (Species Blancoanae 781)*, ii.1915, Bauang, Batangas Province, Luzon (NSW); *Soriano 1909*, 8.iii.1953, Domilio, Passi, Iloila Province, Panay (L); *Taleon s.n.*, 13.ii.1955, Barotac Nuevo, Iloilo Province, Panay (L); *Wenzel 1672*, 25.iii.1916, Leyte (NSW).

SUMATRA: *Korthals s.n.*, s. dat. (L); *Lam 3218*, 28.v.1926, Salibabu, Talaud (L).

VIETNAM: *Pierre s.n.*, iii.1867, flumen Saigon (L).

### 4. *H. phlomoides*

PHILIPPINES: *Merrill 3941*, i.1905, Manila (NSW); *Merrill (Species Blancoanae 753)*, ii.1914, Pasay, Rizal Province, Luzon (NSW).

2. **\**Hygrophila* cf. *triflora* (Roxb.) Fosberg & Sachet, *Baileya* 21 (1981) 147.** — *Ruellia triflora* Roxb., Hort. Beng. (1814) 46; Roxb., Fl. Ind. 3 (1832) 52. — *Adenosma triflora* (Roxb.) Nees in Wallich, Pl. Asiat. Rar. 3 (1832) 79; Nees in A. DC., Prodr. 11 (1847) 68. — *Cardanthera triflora* (Roxb.) Hamilton ex Benth., in Benth. & Hook. f., Gen. Pl. 2 (1876) 1074; C.B. Clarke in Hook. f., Fl. Brit. India 4 (1884) 405. — *Synnema triflorum* (Roxb.) O. Kuntze, Rev. Gen. Pl. (1891) 500.

*Lectotype* (n.v.): *Roxburgh s.n.*, s. dat. in "Herb. Forsyth" (K); selected by Fosberg & Sachet (1984).

Aquatic herb, trailing with emergent parts erect, c. 15 cm long. *Branches* when submerged 4-angled and glabrous, more or less terete when emergent and rather densely covered with erect hairs tipped by a tiny apical gland. *Leaves* when submerged with petioles 5-20 mm long, pinnatifid, c. 3.5-5 cm long, glabrous, when emergent ?merging into bracts, more or less sessile, ovate, c. 2.5 x 2 cm, entire with serrate margins, covered with similar glandular hairs to those on emergent stem. *Inflorescence* of single pedicellate flowers in each bract axil of emergent parts, ? forming a raceme. *Pedicel* c. 4 mm long. *Bracteoles* inserted at base of calyx, sessile, slightly shorter than calyx, obovate, c. 9 x 4 mm, cuneate at base, 3-4 serrations on each side in apical half, covered with glandular hairs as on stem and leaves. *Calyx* segments linear, c. 10 mm x 1 mm, joined at base, covered with glandular hairs. *Corolla* externally with short, moderately dense, erect eglandular hairs except for glabrous tube, internally glabrous except for eglandular hairy palate, colour unknown, tube and throat c. 6-7 mm long, throat c. 4 mm broad; upper lip c. 4 mm long, lobes notched; lower lip c. 8 mm long. *Stamens*: filaments glabrous except for sparse eglandular hairs at very base of longer abaxial pair, abaxial filaments 5.5 mm long, adaxial 2.5 mm long; anther cells narrowly divaricate at base at maturity, shortly pubescent on backs. *Ovary* shortly pubescent, numerous ovules in 2 rows in each cell; style 9.5 mm long, eglandular hairs throughout length; stigma without thickenings at base, single lobe c. 2 mm long, at similar height to longer pair of stamens. *Capsule* not seen, but from Clarke (1885), many-seeded; seed-bearing hooks small and conical, not as large as in other species.

### Distribution

*H. cf. triflora*, apparently a native of India, is known only from Berry Springs, a popular leisure area near Darwin in the Northern Territory. The species is often used in aquaria, which is probably the source of the Berry Springs material. Fig. 18.

### Ecology

The species is found in or on the margins of water. The emergent leaves differ from the submerged ones.

### Notes

1. The specific name for this material has to be confirmed. Fosberg & Sachet (1981) clarified the use of this name and lectotypified this and two other closely related species *H. balsamica* (L.f.) Rafinesque and *H. difformis* (L.f.) Bl. However, following objections by Heine, who had earlier (Heine 1971) considered *H. triflora* to be a synonym of *H. difformis*, they reexamined types and specimens in K and reaffirmed their opinion that the two species were distinct. At the same time they altered their choice of lectotype for *R. triflora* Roxb. From their brief description of the types of these two taxa, Australian material would seem to best fit *R. triflora*, particularly as an examination of the type specimens of *R. difformis* L.f. (Koenig 77 LINN 804.20, microfiche AD) and *R. balsamica* L.f. (Koenig, Ceylon, LINN 804.21, microfiche AD) reveals that they differ from the Australian specimens in leaf shape and the number of flowers in the axils. However, certainty about the name of the species will have to await examination of a range of material, including the lectotype of *R. triflora* Roxb.

2. I am indebted to Mr Clyde Dunlop of DNA for his special efforts in gathering flowering material of this species.

### Specimens examined

NORTHERN TERRITORY: *Briggs* 787, 30.iv.1983, Berry Springs (CBG); *Dunlop* 6680, iv.1984, Berry Springs (DNA).

## 11. BARLERIA L.

There are no native species of *Barleria* in Australia. Of the four species commonly cultivated here at least one, *B. prionitis* L., has escaped in the Northern Territory.

*Barleria* L., Sp. Pl. (1753) 636; L., Gen. Pl. edn 5 (1754) 283; Backer & Bakh. f., Fl. Java 2 (1965) 571.

*Type species: Barleria cristata* L. (India).

Erect herbs or shrubs with cystoliths. *Leaves* petiolate, entire, often spine-tipped, sometimes with spines in axils. *Inflorescences* axillary clusters or terminal spikes, each flower in axil of a large bract sometimes with an apical spine, 2 smaller *bracteoles* at base of calyx usually present. *Calyx* of two unequal pairs of segments inserted at right angles to each other, outer pair (adaxial and abaxial) larger than inner (lateral), each sepal entire or with toothed margins, sometimes spine-tipped. *Corolla* with tube narrow at base, widening into throat; lobes 5, of equal length, lowest lobe fused to adjacent lobes for a shorter length than other 4 lobes, giving 2-lipped appearance, upper lip 4-lobed, lower 1-lobed. *Stamens* 4, inserted at base of throat, one pair fertile and far exserted, others fertile or sterile and included, sometimes with small staminode; anther cells of exserted stamens 2, parallel, inserted at equal levels, medifixed, slightly diverging at base, without appendages, those of included stamens similar or reduced. *Disc* annular. *Ovary* with 1-2 ovules per cell; style long, glabrous; stigma entire. *Capsule* ovoid, acuminate, 1-2 seeds on conspicuous hooks at base. *Seeds* large, discoid, covered with long, appressed hairs which expand and become mucilaginous on wetting. Fig. 19 F-G.

### Distribution

There are about 80 species of *Barleria* mostly in the African and Asian tropics, but with a few in tropical America. The four species recorded for Australia are all introduced and mostly cultivated, although it appears that *B. lupulina* and *B. prionitis* have escaped in the Northern Territory.

### Note

A key is provided to four species of *Barleria* commonly cultivated in Australia. Of these, only *B. prionitis* appears to have become naturalised. The single collection of *B. lupulina* from Katherine (*Pickering DNA 5776*) points to its possible weed potential, but whether this means that the species has become naturalised in that area is not indicated on the sheet. A brief description is provided of that species.

### Key to *Barleria* species cultivated or escaped in Australia

- 1a. Axillary spines present. Margins of calyx segments entire. Flowers yellow, externally eglandular hairy . . . . . 2
- 1b. Axillary spines absent. Margins of calyx segments toothed. Flowers purple, blue or white, sometimes with purple striations, externally glandular hairy . . . . . 3
- 2a. Leaves with red midrib above. Spines in lower branch axils 2. Bracts overlapping throughout inflorescence, broadly obovate, green with a purple upper half, outer surface with cup-shaped glands at base. Sepals shortly hairy all over externally and with some cup-shaped glands . . . . . 2. *\*B. lupulina*
- 2b. Leaves without red midrib. Spines in lower branch axils (2) 3-5. Bracts leaf-like and separate below, overlapping above, lanceolate, green all over, outer surface without cup-shaped glands but frequently gland-dotted. Sepals glabrous externally or with a few glandular hairs in the apical parts . . . . . 1. *\*B. prionitis*
- 3a. Calyx thinly glandular externally; larger pair of calyx segments with spinose margins and apex. Flowers white or purple. Leaves up to 8 x 2-3 cm. . . . . *B. cristata*
- 3b. Calyx strigose; larger calyx segments crenulate or shortly toothed, without apical spine. Flowers blue or lavender. Leaves up to 13 x 5-6 cm. . . . . *B. strigosa*

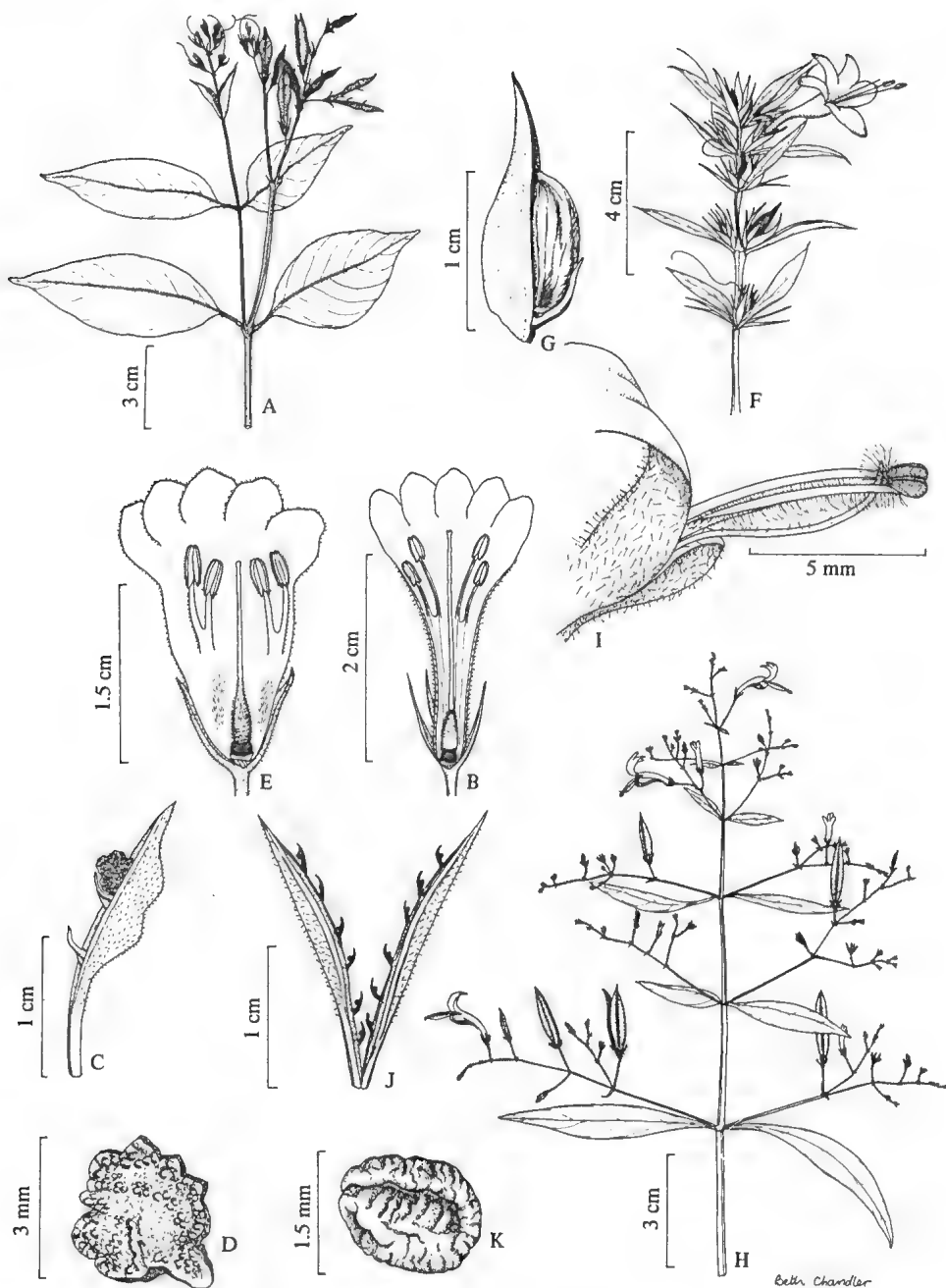


Fig. 19. A-D, *Asystasia australasica* F.M. Bailey. A, habit; B, opened flower (Cameron 2422); C, half a capsule showing seed and seed-bearing hooks (Lawrie 109); D, seed (Cameron 2422). E, *A. gangetica* (L.) T. Anderson, opened flower (Armstrong 12). F, G, *Barleria prionitis* L. F, habit; G, half capsule with hairy seed subtended by a hook (Dunlop 5117). H-K, *Andrographis paniculata* (Burman f.) Wallich ex Nees. H, inflorescence bearing branch; I, flower with details of style and stamen arrangement; J, opened capsule showing seed-bearing hooks, without seeds; K, seed (R.M. Barker 395).

1. *Barleria prionitis* L., Sp. Pl. (1753) 636; Chippendale, Proc. Linn. Soc. N.S. Wales 96 (1971) 259.

*Lectotype*: [India], Herb. Linn. S262.13 (S) fide Wood et al. (1983); *syntypes*: LINN. 805.6, 805.7 (LINN).

Robust prickly shrub to 75 cm high, with long, linear or curved cystoliths in all parts. *Branches* sometimes obscurely 4-angled, decussate, glabrous, with (2-) 3-5 spines, 1-2 cm long in lower axils. *Leaves* gradually intergrading into floral leaves or bracts, petiolate by long tapering base, more or less ovate, 10-13 x 4 cm, margin entire, apex acute and ending in a short spine, herbaceous, upper surface mid-green to reddish-brown (dried), glabrous, lower surface gland-dotted, more or less glabrous, with coarse appressed eglandular hairs sparsely or moderately dense all over or sometimes confined to midrib, margins and main lateral veins. *Inflorescence* spike-like, composed of single flowers in axils of floral leaves or bracts, well-spaced lower down, becoming crowded and with deciduous bracts higher up, rudimentary bud resembling a pair of spines on either side of each noticeable flower in axil. *Bracteoles* lanceolate, slightly shorter than or similar length to calyx, terminated by spine, hard, more or less glabrous. *Sepals* in two pairs at right angles to each other, lanceolate, tapering into a long spine, whitish in colour, cystoliths all over, more or less glabrous apart from scattered glandular and/or eglandular hairs in distal parts; larger segments 12-15 mm long, smaller pair of almost same length, much narrower and often with more pubescence than larger pair. *Corolla* c. 4 cm long, yellow, outer surface covered with fine, lax, eglandular hairs. *Stamens*: filaments of exerted stamens glabrous, 2 smaller staminodes or stamens with hairy filaments also present; anther cells joined in upper part. *Ovary* ellipsoid, glabrous; style with few basal eglandular hairs persistent for short time in fruit. *Capsule* c. 18 mm long, exceeding calyx, glabrous, ovate in outline, tapering into 6 mm long beak; seeds and hooks 1 per valve. *Seed* large, 8 mm x 5 mm, flat, covered with hairs cohering in longitudinal strands which slowly expand on wetting. Fig. 19 F, G.

#### *Distribution and ecology*

*B. prionitis* is found throughout tropical Asia, Africa and India. The original description of the species is based on material from India, but whether it originated there is not known. In Australia there is a recent collection from a vacant block in Darwin. All other collections come from the Victoria River Downs Station area where it is recorded that they may have come from discarded pot plants; whether it is still present needs to be determined as the collections are from the years 1963 and 1964. Fig. 16.

#### *Specimens examined*

NORTHERN TERRITORY: *Dunlop 5117*, 12.iv.1979, Manton St, Darwin (DNA); *Edey R968*, 30.x.1964, Victoria River Downs Stn (DNA); *Edey s.n.*, 20.x.1964, Victoria River Downs (NT); *Edey R1074*, 17.xii.1964, Victoria River Downs, near homestead (DNA); *Lewis s.n.*, early March 1963, Wickham River, Victoria River District (DNA, NT); *Walter R896*, 16.ix.1964, Wickham River frontage, near Homestead (DNA); *Walter s.n.*, 16.xi.1963, Wickham River, Victoria River Downs (NT).

2. \**Barleria lupulina* Lindley, Bot. Reg. 18 (1833) t. 1483.

*Type*: C. Telfair, Mauritius (n.v.), see Typification.

?Erect prickly shrub. *Branches* obscurely 4-angled, glabrous, with 2 downturned spines, c. 1 cm long, in lower axils. *Leaves* with short petiole 2-3 mm long, blade narrowly obovate, 3.5-9.2 x 0.8-1.2 cm, entire, rigid, spine-tipped at apex, glabrous, dark green with red midrib above. *Inflorescence* nodding, or erect terminal spike with overlapping bracts. *Bracts* broadly

obovate, c. 1.5 x 1.2 cm, shortly mucronate, green with purple upper half, shortly pubescent with cup-shaped glands at base of outer surface. *Bracteoles* included in bracts, lanceolate, c. 5.5 mm long, ? spine-tipped, shortly pubescent with predominantly eglandular hairs mixed with few glandular hairs. *Sepals* lanceolate, longer pair c. 1 cm long, shorter pair c. 8 mm long, both spine-tipped, shortly eglandular hairy all over, mixed with cup-shaped glands. *Corolla* yellow, only seen in bud. Mature flowers, capsules and seeds not seen.

### Typification

The type is based on material cultivated in Britain at the Horticultural Society garden. Material of the species, which is a native of Mauritius, was sent to the Society by C. Telfair Esq. according to Lindley (1833) who first described the species. Whether Lindley made a specimen of the original material is not known, but there is no material in CGE (the repository for most of his types). In the absence of a specimen the illustration could be used.

### Distribution

*B. lupulina* is a native of Mauritius, but may have become naturalised in Java. It is used elsewhere as an ornamental houseplant. This is probably the origin of the single Australian record of the species at Katherine in the Northern Territory. Fig. 16.

### Note

As already noted under the genus, the status of the single collection from Katherine is not known; comments on the naturalisation or otherwise of this species would be appreciated as would further collections to expand its description.

### Specimen examined

NORTHERN TERRITORY: *Pickering s.n.*, 1972, Katherine (DNA 5776).

## 12. LEPIDAGATHIS Willd.

*Lepidagathis* has not previously been recorded for Australia, although there are a number of species found in New Guinea. Until the New Guinea species have been revised it is not possible to provide a specific epithet for the Australian material with any certainty.

*Lepidagathis* Willd., Sp. Pl. 3 (1800) 400; R. Br., Prodr. (1810) 478; Nees in Wallich, Pl. Asiat. Rar. 3 (1832) 95; Nees in A. DC., Prodr. 11 (1847) 249; Clarke in Hook. f., Fl. Brit. India 4 (1885) 515; Lindau in Engler & Prantl, Nat. Pflanzenfam. IV, 3b (1897) 312; Clarke in This.-Dyer, Fl. Trop. Africa 5 (1900) 120; Ridley, Fl. Malay Penin. 2 (1923) 586; Bremek., Rec. Trav. Bot. Neerl. 35 (1938) 149; Bremek., Nova Guinea n.s. 8 (1957) 142.

*Type species: L. cristata* Willd. (India)

Herbs or undershrubs, often pubescent, with cystoliths. *Leaves* petiolate, opposite pairs connected by transverse ridge. *Inflorescence* dense, terminal or axillary, bracteate spikes or heads; each bract subtending a flower or second bract of pair sterile. *Bracts* and bracteoles densely clustered, overlapping, decussately arranged, similar in shape, size and indumentum. *Calyx* with 5 unequal segments, adaxial largest, abaxial pair joined to middle, lateral pair narrowest. *Corolla* usually white, small; tube constricted in middle; limb 2-lipped, upper lip entire or emarginate, lower lip 3-lobed and often spotted. *Stamens* 4, inserted at constriction of corolla tube, didynamous, very short; anthers 2-celled, cells parallel, equal, somewhat unequally inserted, without appendages. *Ovary* with 2 ovules per cell; style short; stigma

capitate, entire or grooved. *Capsule* subulate, 1 or 2 seeds with prominent hooks in basal part of each valve, lacking in apical part. *Seeds* discoid, usually pubescent all over. Fig. 17 A-E.

### *Distribution*

*Lepidagathis* consists of approximately 60 species, all of which are tropical and particularly from Africa, India and Malesia. A few American species are sometimes included in this genus, but are more usually (Leonard 1958, Durkee 1978) placed in the genus *Teliostachya* Nees. In Australia there is a single species of uncertain identity.

***Lepidagathis* cf. *royenii* Bremek., Nova Guinea n.s. 8 (1975) 143, fig. 6.**

*Holotype*: van Royen 4150, 13.vi.1954, Foothills of Cycloop Mts, near Hoebal River, District Hollandia (L).

Erect herb, 15-30 cm high, with quadrangular, glabrescent branches. *Leaves* with petiole 0.5-1.5 cm long; blade ovate, 3-9 x 1.5-3.5 cm, tapering at base and apex, margin entire, cystoliths present on both surfaces, upper surface olive-green, leathery, more or less shiny, with 2-ribbed midrib and 3-5 main lateral veins, lower surface paler, lateral veins more obvious. *Inflorescence* a terminal group of 3-5 (or more?) dense spikes, only 1 bract of each pair subtending a flower, other bract sterile. *Bracts* c. 4-4.5 mm long, linear-lanceolate with acute apex, covered with short eglandular hairs, ciliate. *Bracteoles* 2, similar to bracts in size, shape and indumentum. *Calyx* with similar external indumentum to bracts and bracteoles, mixed with occasional glandular hairs; adaxial segment 5.5 x 1.6 mm, abaxial segments joined for c. ½ length, 5.5 x 2.1 mm, lateral segments 5.2 x 0.4-0.5 mm. *Corolla* (only mature buds seen) white, c. 4 mm long, externally with hairy lobes, otherwise glabrous, internally glabrous except for long eglandular hairs at constriction of tube. *Stamens* (in bud): filaments short, 0.2 mm long, hairy at least at base; anthers with cells somewhat unequal in length and insertion, c. 0.4 mm long. *Disc* annular with undulate margin. *Ovary* comose at apex; style 2-2.2 mm long, glabrous. *Capsule* 4-5 mm long, hairy at apex, 4-seeded, each seed with prominent hook at base. *Seed* c. 0.6 mm diameter, with short appressed hairs which expand on wetting. Fig. 17 A-E.

### *Distribution*

*Lepidagathis royenii* Bremek. is recorded from both Irian Jaya and Papua New Guinea. In Australia there are 2 collections possibly referable to this species from the Massey Creek area of Cape York Peninsula. Fig. 20.

### *Ecology*

The annotations on the 2 collections from Australia indicate that the species occurs in "riverine" or "gallery" rainforest. Both collections lack mature flowers but the flowering time would appear to be in October to December.

### *Note*

More work has to be done to ascertain the variability of *L. royenii* Bremek. The Australian collections come closest to this species but differ from the type material in the possession of much larger, non-ferruginous leaves, calyces with glandular and eglandular hairs, the inside of the corolla tube with hairs at the base of the filaments and the inflorescence often consisting of more than three short spikes condensed into a head. A survey of other New Guinea material which could also belong to this species indicates that these also often have glandular hairs on their bracts, their leaves are larger and some possess hairs in the corolla tube while others do not.

*Specimens examined:*

QUEENSLAND: *Clarkson 3602*, 5.xi.1980, Massey Ck, c. 4 km downstream from the mouth of the gorge and 18 km NW of Silver Plains Station (QRS); *Smith 11758*, 11.x.1962, Upper Massey Ck, c. 15 miles a little S of ENE of Coen (BRI).

**Non-Australian species examined****1. *L. royenii* Bremek.**

IRIAN JAYA: *McKee 1882*, 31.xii.1954, Grassy slopes above Ifar (L, LAE); *van Royen 4150*, 13.vi.1954, Foothills of Cycloop Mts, near Hoebal River. Hollandia District (L: holotype).

PAPUA NEW GUINEA: *Brass 31108*, 17.viii.1959, Mt Otto, south slopes (LAE); *Brass 31322*, 3.ix.1959, Mt Michael, NE slopes (LAE); *Brass 31781*, 28.ix.1959, 4 miles S of Akapa (LAE); *Hartley 12122*, 25.vi.1963, along Kainantu-Okapa Rd (LAE); *Hays 410*, 30.vi.1972, 10 miles SE of Obura, Kainantu sub-district (LAE); *Henty NGF 11539*, 25.viii.1959, Maralumi Creek, Erap (LAE); *Henty NGF 20614*, 16.x.1964, near Kundiawa (LAE); *Henty s.n.*, xi.1952, Winima valley, near Wau (LAE); *Henty, Isgar & Galore NGF 38968*, 13.x.1968, Oksapmin, Telefomin subdistrict (LAE); *Hide 162*, 15.viii.1972, ¼ mile NNW Koge Mission, Sinasina (LAE); *Hoogland 4335*, 21.vii.1954, Castle Hill near Tapio, Cape Vogel Peninsula, Milne Bay District (LAE); *Nelson 74*, 21.viii.1968, Alimp, S Nebilyer Valley, Hagen sub-district (LAE); *Pullen 1159*, 26.ix.1958, Lower Ramu-Atitau area, near Potsdam Harbour, Bogia sub-district (LAE); *Streimann & Kairo NGF 25864*, 22.iii.1971, Nauti Village, Upper Watut, Wau sub-district (LAE); *Streimann & Kairo NGF 35834*, 26.iii.1968, Clean Water, Wau Forestry (LAE); *Womersley NGF 11404*, 2-9.ix.1959, Kini Creek, NE slopes Mt Michael (LAE); *Womersley and Millar NGF 14580*, 13.vi.1962, Kauli Creek, Anderson Logging area, above Wau (LAE).

**2. *L. sorongensis* Bremek.**

IRIAN JAYA: *van Royen 4086*, 10.v.1954, Sorong, Klabala river, NE of the town, near Top Die Camp (L: holotype); *van Royen 3061*, 19.iii.1954, Sorong. Hills N of town behind buildings of Forest Dept. (L).

**13. ANDROGRAPHIS Wallich ex Nees**

*Andrographis* was first described by Wallich in 1832. The only species found in Australia is introduced; it may have originally been cultivated for its reputed medicinal properties.

*Andrographis* Wallich ex Nees in Wallich, Pl. Asiat. Rar. 3 (1832) 77, 116; Nees in A. DC., Prodr. 11 (1847) 515.

*Type species: A. paniculata* (Burman f.) Wallich ex Nees (India).

Herbs with cystoliths. *Leaves* shortly petiolate, entire, opposite pair connected by transverse ridge. *Inflorescence* (in Australia) a terminal panicle, bracts leafy at base, becoming smaller higher up. *Bracteoles* 2, small, at base of pedicel. *Calyx* of 5 more or less equal segments. *Corolla* tubular at base, curved; limb 2-lipped (in Australia), upper lip 3-lobed, lower entire or shortly notched. *Stamens* 2, far exserted (in Australia) or included; filaments pubescent; anther cells 2, parallel, inserted at equal level, joined at base. *Disc* annular. *Ovary* with each cell with 4-7 ovules in two rows; style exserted (in Australia) or included, curved upwards at apex; stigma entire or shortly bilobed. *Capsule* erect, elliptic in outline, compressed, seed-bearing throughout, each valve with 4-7 seeds and conspicuous hooks. *Seed* small, glabrous, dimpled, not noticeably compressed. Fig. 19 H-K.

*Distribution*

*Andrographis* consists of about 18 species confined to a region encompassing India, China and west Malesia. The only Australian species, *A. paniculata*, is probably introduced.



***Andrographis paniculata*** (Burman f.) Wallich ex Nees in Wallich, Pl. Asiat. Rar. 3 (1832) 116; Nees in A. DC., Prodr. 11 (1847) 515; Clarke in Hook. f., Fl. Brit. Ind. 4 (1885) 501; Chippendale, Proc. Linn. Soc. N.S. Wales 96 (1971) 259. — *Justicia paniculata* Burman f., Fl. Indica (1768) 9.

*Type: Burman*, In Malabarica et Zeylona. (n.v., but probably in G or L).

Perennial herb, 0.5-1 m high. *Branches* 4-angled, with sometimes inconspicuous, small cystoliths, glabrous apart from few eglandular hairs at nodes. *Leaves* ovate, 6-10.2 x 1.5-2.4 cm, smaller in younger parts, gradually intergrading with bracts, long attenuate at base, slightly crenate, long acuminate at apex, dark green above, light green below, with short, linear cystoliths (sometimes inconspicuous) on both surfaces, glabrous, often gland-dotted; midrib often 2-ribbed at base. *Inflorescence* composed of shorter panicles in each of axils of upper leaves, combined into a lax compound, terminal panicle. *Bracts* narrowly ovate, c. 1-2 mm long, usually subtending 1 flower. *Bracteoles* 2 at base of pedicel, green, narrowly ovate, 0.8-1 mm long. *Pedicel* of mature flowers 1.5-5.0 mm long, moderately dense spreading eglandular hairs mixed with few glandular hairs. *Calyx* segments 2-3 mm long, acute, shortly joined at base, spreading glandular and shorter eglandular hairs on outer surface, appressed eglandular hairs internally. *Corolla* 5-6 mm long, tubular for half length, mixture of glandular and eglandular hairs externally; upper lip recurved, white or pink with purple or darker patches at base; lower lip entire or shortly 2-lobed, decurved to meet corolla tube, white. *Stamens* 2, inserted at top of tube; filaments expanded at base, abaxial side lined by moderately dense, long, lax eglandular hairs; cells deep purple to black, more or less obovate, joined at base to each other by basal membrane, bearing long filamentous hairs similar to those on filaments, cells fused in upper half when young. *Ovary* ellipsoid, with cover of short glandular hairs, c. 6 ovules per cell; style with few eglandular hairs in lower half, curved at apex, stigma entire. *Capsule* narrow ellipsoid, 14-17 x 3 mm, sparsely glandular hairy externally; each valve with central longitudinal furrow and 6 seeds and hooks; hooks narrowed at base, apically more or less sagittate. *Seeds* almost rectangular, 18-20 x 14-15 mm, dimpled all over, brown, longitudinally with 2 deep furrows. Fig. 19 H-K.

### *Distribution*

In Australia all collections are from the Darwin area in Northern Territory, where the earliest collection was made in 1958, possibly indicating a comparatively recent introduction. As stated by Mr C. Dunlop (pers.comm., 1982) "it is so suited to its habitat (it could be) considered to be native except for the lack of early records and its parochial occurrence". Fig. 20.

### *Ecology*

*A. paniculata* is a species with weedy characteristics being found in disturbed sites. However, it has also been noted within monsoon forest (*Must 1186*). Flowering and fruiting specimens have been collected from November to June.

### *Note*

The introduction of this species into cultivation and subsequent naturalisation may be associated with its purported medicinal properties. Clarke (1885) notes that it was cultivated in the East and West Indies and Usher (1973) records a tonic made from its roots and leaves as being useful against "dysentery, diarrhoea, intestinal worms, stomach complaints and to reduce fevers".

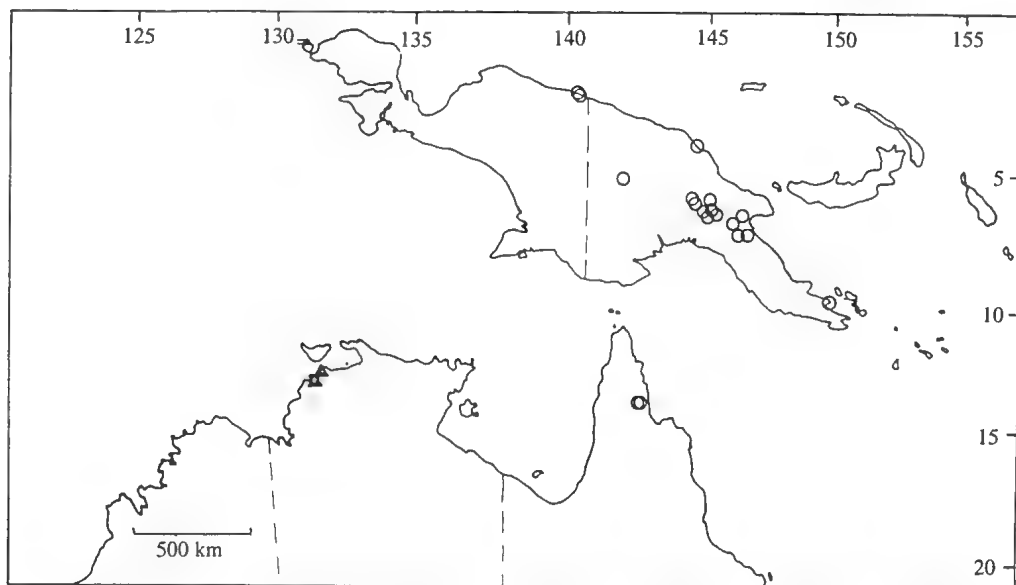


Fig. 20 Distribution of ▲ *Andrographis paniculata* and ○ *Lepidagathis* cf. *royenii* in Australia and New Guinea.

### Specimens examined

NORTHERN TERRITORY: *R.M. Barker* 395, 1.v.1983, Berry Springs Nature Reserve, turnoff 44 km S of Darwin on Stuart Hwy (AD); *Byrnes* NB 871, 26.vi.1968, Darwin (AD, DNA, NT); *Chippendale* s.n., 26.v.1958, Mindil Beach, Darwin (BRI, MEL, NSW, NT); *Cousins* 7, 10.v.1978, Winnellie, Darwin (DNA); *Hooper* 15, 16.v.1963, Darwin racecourse (BRI, NT); *Muspratt* SSO 518, 28.iii.1963, Darwin City (DNA); *Must* 1186, 26.ii.1974, East Point (CANB, DNA); *Nelson* 1030, 5.vi.1964, A.I.B. (Animal Industry Branch), Mitchell St, Darwin (AD, NT); *Robinson* R 1182, 9.ii.1965, East Pt Road, Darwin (NT).

## 14. ASYSTASIA BL.

*Asystasia* is represented by two species in Australia. One of these, *A. gangetica* is introduced, while the other is confined to the Torres Strait Islands. A third unnamed taxon is found on Cape York Peninsula. Typification of the genus is discussed at some length.

**Asystasia** Bl., Bijdr. (1826) 796; Nees in Wallich, Pl. Asiat. Rar. 3 (1832) 89; Nees in A. DC., Prodr. 11 (1847) 163.

*Type Species*: Uncertain, possibly *A. nemorum* Nees or *A. blumei* Nees from Java — see Typification.

Erect or scandent herbs, or shrubs with dot-like cystoliths. *Leaves* petiolate, opposite pair connected by transverse ridge. *Inflorescence* terminal or axillary raceme, flowers single or paired. *Bracts* 2, small; *bracteoles* 2, similar to bracts. *Calyx* with 5 segments, free almost to base, more or less equal, acute. *Corolla* more or less regular, funnel-shaped, tube narrowed at base, widening into throat; lobes 5, spreading, imbricate in bud, more or less equal, abaxial one with a palate ? in form of longitudinal fold. *Stamens* 4, inserted in pairs in widened part of

corolla tube, usually included, didynamous or equal; anthers 2-celled, cells parallel, inserted equally, sometimes with small awn just above base. *Disc* annular. *Ovary* with 2 ovules per cell; style long; stigma thickened, bilobed. *Capsule* clavate, basal part lacking seeds; seed-bearing hooks prominent, confined to expanded portion. *Seed* 2 or 4, large, compressed, more or less triangular with angled margins, tuberculate or smooth on sides, glabrous. Fig. 19 A-C.

### Typification

The genus *Asystasia* was first described by Blume (1826) based on his own Buitenzorg (Java) collection(s). To this material he gave the name *A. intrusa* as he considered it to be synonymous with an Arabian species *Ruellia intrusa* Forssk.

Nees (1832) described 11 new species of *Asystasia* from Asia, including *A. nemorum* for which he cited collections in "Herb. Russel, Madrasp. and Heyne" from East India. He also considered this species to extend to Java as he included a direct quote from Blume's original description of *A. intrusa*: "In umbrosis humidus, circa Buitenzorg. Floret: omni fere tempore". Thus, he placed Blume's Javan material under the Indian taxon *A. nemorum*, while the Arabian *Ruellia intrusa* Forssk. was included under his *A. coromandeliana* (= *A. gangetica* (L.) T. Anders.). There is no evidence that Nees actually saw Blume's material from Java.

Later, Nees (1847a) treated *A. intrusa* (Forsskål) Nees as a separate species from Arabia, and again referred Blume's collection to the Indian species *A. nemorum*, quoting the same Indian specimens as in his 1832 publication and again including the quotation from Blume (l.c.) with respect to the Javan collection(s). However, Blume's same quotation also appears under the species, *A. blumei*, for which specimens from Gunong R and (? Mandjinnang) in Java were seen by Nees in "Herb. Junghuhn".

There are thus 3 possibilities which need to be considered for selection of the type species of the genus *Asystasia*.

#### (i) *A. intrusa* (Forsskål) Bl.

The type species of the genus *Asystasia* is usually cited as *A. intrusa* (Forsskål) Bl. (see Bremekamp in 1979 in "Index Nominorum Genericorum"). However, unless the Arabian collections of *Ruellia intrusa* Forsskål are conspecific with Javan material seen by Blume (and this seems unlikely as its affinities appear to lie with *A. gangetica* (L.) T. Anderson) this cannot be considered the type of the genus. Blume's description is clearly based on Javan material.

#### (ii) *A. nemorum* Nees

The type of the genus must depend on the identity of the Javan material collected and described by Blume. Nees assigned it to *A. nemorum*. However, while he did see and cite a number of Indian collections there is no indication that he actually saw Blume's collections. It is therefore likely that the lectotype of *A. nemorum* Nees would be chosen from the Indian material. Only if the Indian and Javan material are conspecific would the type of the genus then be *A. nemorum* Nees. Clarke (1885) and Bremekamp (1948) considered they were not conspecific; the Indian material cited by Nees was assigned by Clarke (l.c.) partly to *A. crispata* Benth. and partly to *A. violacea* Dalz. ex Clarke. It should be noted that *A. nemorum* takes priority over these if the lectotype comes from amongst the Indian material.

#### (iii) *A. blumei* Nees or another Javan species

If the Indian and Javan material of *A. nemorum* are not conspecific then *A. blumei* is the other species to which Blume's description was assigned by Nees (1847), together with the Junghuhn collections from Java. The Junghuhn collection and Blume material will need to be

compared to determine whether the name *A. blumei* can be applied to the latter, or whether other Javan species need to be investigated. Until this is done the name of the type species of the genus will remain unclear, although it must ultimately derive from the Blume collection(s) from Buitenzorg.

### Distribution

The genus *Asystasia* is native to tropical India, Asia and Africa and probably consists of 40-50 species, but is in need of worldwide revision. In Australia there are three species, of which one is introduced.

### Note

*Asystasia* and *Pseuderanthemum* specimens have frequently been confused in the past as shown by the fact that all Australian material of *A. australasica* had been identified as *Pseuderanthemum variabile*, while most New Guinea material of *Pseuderanthemum* has been referred to one of the species of *Asystasia*. The two genera do resemble each other but can be readily distinguished by the number of stamens (2 in *Pseuderanthemum*, 4 in *Asystasia*), the differences in their seed shapes (see Figs 19 & 22) and presence of glandular hairs on the capsules and the corolla exterior in *Asystasia*.

### Key to *Asystasia* species in Australia

- 1a. Inflorescence with flowers in pairs along rachis. Style glabrous at base. Calyx and pedicel glabrous. Anthers without small awn just above base of cell. Corolla tube with narrowed part longer than widened part ..... 2. *A. australasica*
- 1b. Inflorescence with flowers arranged singly along rachis. Style pubescent at base. Calyx and pedicel pubescent. Anthers with a small awn just above base of cell. Corolla tube with narrowed part much shorter than widened part ..... 2
- 2a. Ovary with dense eglandular hairs mixed with smaller glandular hairs nearly all over. Stamens more or less equal in length. Seed smooth on flattened sides ..... 1. *\*A. gangetica*
- 2b. Ovary glabrous or with a few sparse eglandular hairs mixed with denser glandular hairs. Stamens didynamous. Seed tuberculate on flattened sides ..... 3. *A. sp.*

1. *Asystasia gangetica* (L.) T. Anderson in Thwaites, Enum. Pl. Zeyl. (1860) 235; T. Anderson, J. Linn. Soc. 9 (1867) 525; Leonard, Contrib. U.S. Nat. Herb. 31 (1958) 288; Heine in Hepper, Fl. W. Trop. Africa 2 (1963) 413; Backer, Fl. Java 2 (1965) 576; J. Green, Census Vasc. Pl. W. Austral. (1981) 95. — *Justicia gangetica* L., Centuria 2 (1756) 3.

*Type: Anon. s.n., s. dat. India (LINN 28.26, 28.27: syntypes).*

*A. coromandeliana* Nees in Wallich, Pl. Asiatic. Rar. 3 (1832) 89; Nees in A. DC., Prodr. 11 (1847) 165; C.B. Clarke in Hook. f., Fl. Brit. India 4 (1885) 493; Clarke in Dyer, Fl. Trop. Africa 5 (1900) 131; Clarke in Dyer, Fl. Capensis 5 (1912) 42; Ridley, Fl. Malay Penins. 11 (1923) 586: nom. illeg.

Dense shrub or subshrub to 1 m high, ? erect, creeping or climbing. *Branches* more or less quadrangular, sometimes furrowed on two sides, often constricted above nodes, often with two longitudinal rows of hairs, nodes pubescent, otherwise glabrous. *Leaves* with petioles 2-10 mm long, blade ovate, 15-45 x 5-30 mm, acuminate at apex, truncate at base, more or less entire or shallowly erose, glabrous, or sparse hairs on midrib and main lateral veins, rarely throughout (Armstrong 12, 13). *Inflorescence* an axillary or terminal, often 1-sided raceme, 4-10 cm long; flowers single at nodes, sparse. *Bracts* in opposite pairs on either side of peduncle, usually with 1 flower, triangular, 0.8-1.5 mm long, eglandular hairs on outer midrib and margins. *Bracteoles* similar in shape and indumentum to bracts but smaller. *Pedicel* 0.5-1.5 mm long, eglandular and glandular pubescence similar to that on calyx. *Calyx* 5-8 mm long, outer surface glabrous

or with glandular and eglandular hairs; inner surface with dense cover of appressed, shining eglandular hairs. *Corolla* blue, mauve or white, moderately dense cover of eglandular and glandular hairs on outer surface, glabrous internally except for 2 lines of hairs at base of filaments; tube and throat c. 1.5-2 cm long, tube half length of throat; lobes c. 8.5 mm long. *Stamens* more or less equal, each pair arising 3.5-4 mm above base, free for c. 4 mm; filaments with glandular hairs on one side; cells sparsely eglandular and glandular hairy on back just above base. *Ovary* with extremely dense cover of long eglandular hairs mixed with shorter, less conspicuous glandular hairs; style 1.4-1.6 cm long, hairy in basal part. *Capsule* (2 seen) 20-25 mm long, with glandular and eglandular hairs over outer surface; seed-bearing hooks 2 in each valve, often 1 and its seed not developing fully. *Seed* (1 seen) 4 x 4 mm, smooth on sides. Fig. 19E.

### Distribution

*A. gangetica* is a native of the Old World tropics, but has been introduced into tropical America (Leonard 1958). It has also been introduced into Australia where it is known from several collections from Queensland, some of which may be naturalised. There is a cultivated specimen from the Kimberley Research Station Garden near Kununurra, Western Australia, but no evidence of its naturalisation in that region. Fig. 21.

### Ecology

The few collections seen were mainly cultivated or probably recent escapes from cultivation. However the collection from Woodstock indicated that the plant was freely eaten by all classes of stock, suggesting the establishment of *A. gangetica* amongst other pasture species. All collections contained flowers.

### Notes

1. There is some doubt whether Australian material may be referred to *A. gangetica* as the specimens are much smaller in many parts than measurements given for the corresponding species in Java (Backer 1965), and the seed is not tuberculate on the flat surface. This reduction in size of floral parts of Australian material compared with Javan and other Malesian material is not unknown elsewhere in the family (see *Acanthus ilicifolius*). As the species is regarded as extremely variable throughout its range, only a revision of *A. gangetica* in its entirety can establish whether the Australian material differs significantly.

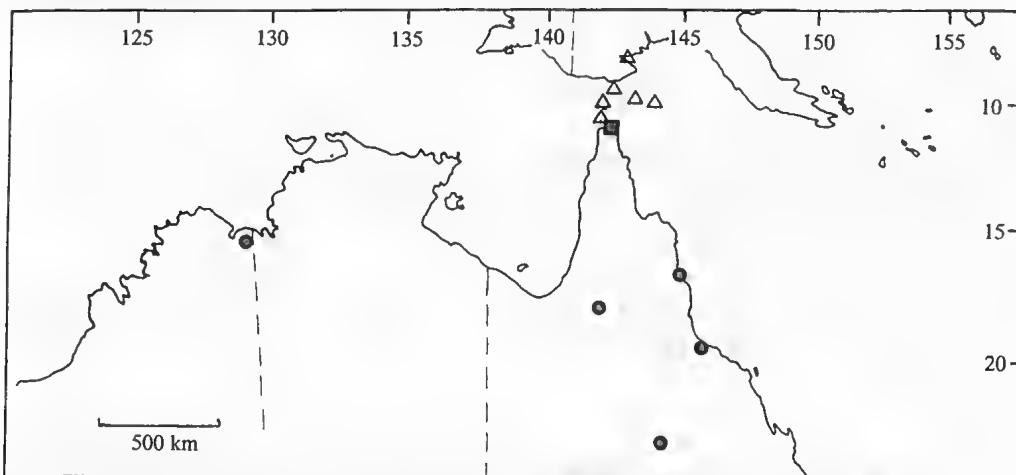


Fig. 21. Distribution of *Asystasia* in Australia and New Guinea (● *A. gangetica*; △ *A. australasica*; ■ *A. sp.*).

2. The Morris collection of *Asystasia* from Harvey Creek in North Queensland has been identified by C.T. White as *A. travancorica* Beddome, a species native to India and closely allied to *A. gangetica* according to Clarke (1885). As the specimen contains only half a bud and 2 capsules without seed it is impossible to place it with any species.

### *Specimens examined*

QUEENSLAND: *Armstrong 12 & 13*, 8.x.1980, Houseyard in Croydon town (BRI); *de Faria s.n.*, 14.xi.1950, West Cairns (cultivated) (QRS 02020936); *Wordsworth s.n.*, 6.iv.1928, Woodstock (BRI 112042); *White 12409*, 20.xi.1943, Barcaldine, in small public park next to town hall (BRI).

WESTERN AUSTRALIA: *Richards 45*, 7.ix.1942, Kimberley Research Station garden, Kununurra (CANB, PERTH: 2 sheets).

Specimen questionably referred to *A. travancorica* Beddome

QUEENSLAND: *Morris (Herb. Flecker 2519)*, 2.xi.1936, Harvey Creek (QRS).

2. *Asystasia australasica* F.M. Bailey, Qld Ag. J. 1 (1897) 230; Bailey, Qld Fl. 4 (1901) 1156; Bailey, Compr. Cat. Qld Pl. (1913) 374.

*Holotype*: F.M. Bailey *s.n.*, vi.1897, Thursday Island (BRI); *Isotype*: (K).

Erect, ? spreading herb to 30 cm high. *Branches* more or less quadrangular, usually constricted above nodes, often with 2 longitudinal rows of hairs and dense fine hairs at nodes otherwise glabrous. *Leaves* with petiole 3-22 mm long, shorter higher up; blade membranous, ovate, to 35-85 x 11-35 mm, attenuate base, entire, acuminate at apex, with sparse fine white hairs on upper and lower surface, denser on petiole, midrib and veins of young leaves, small, round cystoliths on upper surface only. *Inflorescence* racemes c. 2-4 cm long, mostly terminal, rarely arising from axils; flowers opposite, overlapping. *Bracts* triangular, c. 1.2 mm long, usually glabrous, sometimes with apical tuft of eglandular hairs. *Bracteoles* similar to bracts in shape and indumentum, slightly smaller. *Pedicel* 1-2 mm long, glabrous. *Calyx* 4-6 mm long, outer surface glabrous except sometimes for apical tuft of eglandular hairs, inner surface glabrous or with sparse fine hairs. *Corolla* blue, purple or lavender, dense cover of glandular and eglandular hairs externally, internally glabrous except for tube with sparse eglandular hairs; tube and throat 15-17 mm long, tube twice as long as throat; lobes more or less equal, c. 4-5 mm long. *Stamens* unequal, longer (abaxial) of each pair just exerted, with glandular hairs on basal half of filaments; filaments of each abaxial and adaxial pair fused at base for c. 0.5 mm, longer filaments 2-4.5 mm long, shorter filaments 1.2-3 mm long; anthers of shorter adaxial stamens just reaching or overlapping base of anthers of longer abaxial stamens, cells without spur at base, glabrous on backs. *Ovary* glabrous in young flower, later with sessile glands and short upright eglandular hairs; style 10-18 mm long, glabrous. *Capsule* 15-20 mm long, moderately dense glandular hairs over outer surface; seed-bearing hooks 2 in each valve, often only 1 with seed developing fully. *Seed* c. 3.5 mm diameter, tuberculate, flattened on sides. Fig. 19 A-D.

### *Distribution*

*A. australasica* is known only from Torres Strait islands. It may prove to be conspecific with the widespread Malesian species *A. oppositiflora* Bremek. (see Note). Fig. 21.

### *Ecology*

Annotations on specimens include "growing on sandy flat behind beach and mangroves and into grassy burnt area" (*Cameron 2422*), "in grass over on plantation clearing" (*Brass 6276*) and "on low sand island carrying a tall closed scrub overtopped by well-spaced

*Casuarina equisetifolia*". Clarkson further describes the species as "a common weed of the village". Flowering material has been collected in a number of months of the year and there appears to be no specific flowering time.

Note

Australian material of *A. australasica* differs from type material of *A. oppositiflora* Bremek. by its glabrous pedicels and calyces, its densely glandular hairy corolla exterior and ovary, and its slightly smaller flowers (Table 15). These differences are, however, relatively insignificant and not always clear cut so that the two species must be considered closely related. Should the two be found to be conspecific, the epithet '*australasica*' would have priority.

From descriptions (Backer 1965) the Javan species cited as *A. nemorum* Nees also appears to be closely related to *A. oppositiflora*, differing from it in the included anthers, smaller flowers (in which the narrower tube is not longer than the wider throat) and flowers apparently mostly arranged singly along the rachis (Table 15). It is therefore possible that the other two species may prove conspecific with it, although it seems unlikely that the name *A. nemorum* is applicable (see Typification of *Asystasia*).

Character	<i>A. gangetica</i>	<i>A. australasica</i>	<i>A. oppositiflora</i>	<i>A. sp.</i>	' <i>A. nemorum</i> '
Inflorescence: flowers	single	opposite at least at base	all opposite, rarely opposite triads	single	mostly solitary*
Bract and bracteole length	0.8-1.5 mm	1-2 mm	0.6-1.5 mm	3 mm	—
Pedicel: length	0.5-1.5 mm	1-2 mm	1.2-1.6 mm	c. 1 mm	—
Hair covering	eglandular	glabrous	pubescent	eglandular	—
Calyx: length	5-8 mm	4-6 mm	6-7 mm	4.5-6 mm	—
pubescence	glandular & eglandular all over	glabrous, often with apical tuft of hairs	pubescent, with glandular and eglandular hairs	glandular & eglandular at base, longer eglandular on lobes	more or less glabrous
Corolla: tube:throat	1:2	2:1	2:1	c. 1:2	1:1
total length	2.8 cm	2.7 cm	2.5-3 cm	c. 1.7 cm	2.5-3 cm
Ovary	dense eglandular and glandular hairs	glandular	softly hairy at apex	glabrous or glandular	—
Style: length	1.4-1.6 cm	1.7-1.8 cm	2.6-2.8 cm	1.5-1.6 cm	—
pubescence	basally hairy	glabrous	glabrous	basally hairy	—
Stamens 4	more or less equal	didynamous	didynamous	didynamous	—
Abaxial and adaxial filaments	fused for 3.5-4 mm	fused for 0.5 mm	fused for 1.5 mm	—	—
length (free part)	4 mm	4.5 & 3mm	6 & 3 mm	4.5 & 3 mm	—
Anthers	mucro just above base	mucro absent	?mucro absent	mucro present	—

\*According to Backer (1965), but Clarke records Indian *A. nemorum* as having mostly opposite flowers (1885). This may be because they are different species as discussed in Typification of the genus.

Table 15: Comparison of the morphological characteristics of *Asystasia* species from Australia, New Guinea and Java. Information for *A. oppositiflora* from specimens and Bremekamp (1948), for '*A. nemorum*' from Backer (1965).

Type material of *A. australasica* and *A. oppositiflora* has been seen, but that of *A. nemorum* has yet to be studied. Examination of the types will not be sufficient to resolve the taxonomy of the three taxa, a revision of this group being required throughout their geographical range.

In the case of Australian material of *A. australasica* the collections were mostly made last century and consist predominantly of fragments (almost invariably mixed with *Pseuderanthemum variabile*). Without good flowering material, with observations of flower colour and shape, and population collections to determine the extent of variation, there is little chance of resolving the taxonomy satisfactorily.

### *Specimens examined*

QUEENSLAND: TORRES STRAITS: *Bailey s.n.*, 1897, Thursday Island (BRI: holotype, K: isotype); *Brass* 6276, 5.iii.1936, Daru Island (LAE); *Cameron* 2422, 31.vii.1975, Dauan Island (QRS); *Chalmers s.n.*, 1878, Jervis Island (MEL 101138 p.p.); *Chalmers s.n.*, 1878, Murray Island (MEL 101088); *Chalmers s.n.*, 1878, Thursday Island and Jervis Island (MEL 101135 p.p.); *Clarkson* 3965, 28.x.1981, Yorke Island (AD); *Lawrie s.n.*, 12.ix.1971, Dauan Island (BRI); *Lawrie* 109, vii.1970, Murray Island (BRI); *Sinclair s.n.*, 1886, Thursday Island (MEL 101117 p.p.); *Tate* 7, v.1905, Thursday Island (BRI p.p.).

JAVA: *Backer* 31161 & 37687, 24.iv.1930, Kepoh near Parvervea (L: 3 sheets).

NEW GUINEA: *Bäuerlen* 39, xi.1885, Fly River (MEL: 2 sheets).

### 3. *Asystasia* sp.

Sprawling herb. *Branches* more or less quadrangular, longitudinally grooved, not noticeably constricted above nodes, either hairy all over or with hairs in two rows. *Leaves* with petioles 5-7 mm long; blade more or less ovate, 17-35 x 12-23 mm, attenuate at base, obtuse at apex, velutinous hairs on both surfaces, cystoliths indistinct. *Inflorescence* axillary or terminal, often 1-sided, to 13 cm long; flowers arranged singly and sparsely. *Bracts* lanceolate, up to 3 mm long, externally glabrous except for occasional eglandular hairs at apex, internally with few sparse hairs. *Bracteoles* similar in size, shape and indumentum to bracts. *Pedicel* c. 1 mm long, eglandular hairy. *Calyx* 4.5-6 mm long, lower outer surface with a mixture of glandular and eglandular hairs, upper parts with stouter 5-8-celled eglandular hairs, inner surface with fine appressed hairs. *Corolla* purple, externally sparsely hairy, glabrous internally, possibly with 2 rows of hairs in tube; tube and throat c. 8-10 mm long, tube much shorter than throat; lobes c. 7 mm long. *Stamens* didynamous, longer abaxial pair ? just exerted, longer pair 4.5 mm long, shorter adaxial pair 3 mm long; cells glabrous on backs, with short spur just above base. *Ovary* glabrous or with few short eglandular hairs and/or relatively dense more or less sessile, glandular hairs; style 1.5-1.6 cm long, hairy in basal part. *Capsule* 15-17 mm long, glandular and eglandular hairs all over; seed-bearing hooks 2 in each valve, often only 1 with seed developing fully. *Seed* c. 3 mm diameter, tuberculate on flattened side.

### *Distribution*

This *Asystasia* species is known by only one collection from Cape York Peninsula. Fig. 21.

### *Ecology*

It is recorded as "common in shade of scrub of coastal sand dunes . . . forming a thin ground cover in places". The collection, made in May, has both flowers and mature seed-bearing capsules.

### *Note*

This collection possesses characteristics of both *A. gangetica* and *A. australasica* (Table 15). In its inflorescence, corolla shape, awned anthers and style pubescence it resembles



*A. gangetica*, while it approaches *A. australasica* in the pubescence of the ovary, didynamous stamens and tuberculate seeds. Whether this represents a distinct species or part of a more variable complex must await revision of the whole genus or at least the Malesian representatives. In the meantime more material would be appreciated from Cape York Peninsula.

#### *Specimen examined*

QUEENSLAND: *Brass* 18671, 7.v.1948. Newcastle Bay, 2½ miles S of Somerset. (BRI, CANB).

### 15. PSEUDERANTHEMUM Radlk.

#### 1. *Generic circumscription*

The two Australian species of *Pseuderanthemum*, the first recognized by Brown (1810), the second by Bentham (1868), were originally described under the Linnaean genus *Eranthemum*. Brown (l.c.) had considered the genus to be "scarcely natural" consisting as it did of Indian species with dense spikes and leafy subtending bracts together with other species from India, Africa and Australia with lax, spike-like fascicles and short subulate bracts. Nees von Esenbeck's treatment (1847a) recognised these differences by reference to two unranked groups *Grandibracteata* and *Parvibracteata* under *Eranthemum*, corresponding with the bract differences already recognised by Brown.

In 1860 T. Anderson segregated from *Eranthemum* a new genus *Daedalacanthus* with a single species, *D. montanus*, from Ceylon. Later, Anderson (1867) added to the genus a further 14 Indian species, many based on species included by Nees under '*Grandibracteata*'. *Daedalacanthus* was placed in Anderson's tribe Ruellieae, while *Eranthemum* was placed within his tribe Asystasieae. Bentham (1876) followed Anderson in recognising the two genera, considering *Daedalacanthus* to consist of all but one species of *Eranthemum* '*Grandibracteata*' of Nees, while *Eranthemum* comprised the majority of the remaining species. He placed *Eranthemum* within tribe Justicieae and *Daedalacanthus* within tribe Ruellieae.

Nomenclaturally this proved incorrect. Radlkofer (1883) showed that the type of *Daedalacanthus* (*D. montanus* (Roxb.) T. Anderson) was conspecific with the type of *Eranthemum*, *E. capense* L.; this is apparently confirmed by Nees's placement of *E. capense* L. as a synonym of *E. montanum* Roxb. in his earlier (1847a) paper and by Trimen's (1888) study of the type of *E. capense* L. in Hermann's herbarium in which Trimen attributed it to *Daedalacanthus montanus*. Radlkofer proposed a new name *Pseuderanthemum* for those species previously placed under *Eranthemum* by Anderson and Bentham, and listed on a distributional basis, often with reference to previous publications, all species which he considered belonged under *Pseuderanthemum*. He thereby made the new combinations within *Pseuderanthemum* in this paper. On the basis of pollen types, Radlkofer (l.c.) included *Eranthemum* L., with honey-combed or ribbed pollen, within the tribe Ruellieae and *Pseuderanthemum*, with pollen apparently shaped like a belt and buckle ("spangen"), near the Asystasieae, a similar placement to that of Anderson (1864, 1867).

Leonard (1958, p. 728) proposed that Radlkofer did not validate his name on the grounds that there was no description of *Pseuderanthemum* and that previous works referred to by Radlkofer contained only descriptions of species. He argued that *Pseuderanthemum* was not validly published until 1895 when Lindau described the genus, overlooking that *Siphoneranthemum* (Oersted) O. Kuntze, published in 1891, would then have had priority.

Leonard (l.c.) erred, firstly in considering there was no generic description, for the description of the pollen satisfies this requirement, and secondly because Radlkofer refers to three papers by Anderson, in two of which (Anderson 1864 p. 18, 1867 p. 446) were

given a short description of the genus to which the name *Eranthemum* had been misapplied: "*Eranthemum*" Stamina 2, cum rudimentis 2 steriliis; antheris bilocularibus, loculis plus minus divaricatis muticis". Radlkofer also refers to Bentham's full descriptions of "*Eranthemum*" and *Daedalacanthus* in "Genera Plantarum" (1876). By references to these earlier papers and his statement that *Pseuderanthemum* replaces Anderson's and Bentham's "*Eranthemum*", Radlkofer satisfied the requirements of Art. 32 of the ICBN for the valid publication of *Pseuderanthemum*.

## 2. History of the Australian species of *Pseuderanthemum*

The most widespread of the species of *Pseuderanthemum* was first described by Robert Brown (1810) as *Eranthemum variabile*, the specific epithet of which has proved to be entirely appropriate. Brown recognised three infraspecific taxa  $\alpha$ ,  $\beta$  and  $\varphi$ , mainly on leaf shape differences, and these were subsequently named by Nees von Esenbeck (1847a) as var. *integrifolium*, var. *dentatum* and var. *lineare* respectively.

Bentham (1868) also recognised two varieties, var. *molle* and var. *lineare*, the latter having different syntypes from the earlier described variety of the same name. In addition to these Bentham also described a third taxon from Lord Howe Island which he referred to "var. ? *grandiflora*", but considered it might be a distinct species.

Domin (1929) overturned previous concepts of the species. He treated *P. variabile* as a species spreading from Australia into New Guinea and Polynesia. Within it he recognised six varieties of which the only one to occur in Australia was the typical variety (his var. *typicum*). In the confusing text he also ascribed to the species within Australia two other species, *P. ultralineare* and *P. grandiflorum*, both based on previously recognised varieties. The implication then is of a "super species", *P. variabile*, containing two lesser species or perhaps a species with two "subspecies", although there is no doubt that he attributed them with specific rank. The numbering of the species and their position in the text gives the impression that Domin conceived them as part of *P. variabile*. However, by implication in the text, in the index and from his annotation of the specimens, there seems little doubt that he regarded *P. ultralineare* and *P. grandiflorum* as distinct species; this is how they have been treated here for the purposes of synonymy.

Again in a somewhat confusing way (see *P. variabile*: Typification 5) Domin (l.c.) circumscribed within *P. grandiflorum* most of the variation which had traditionally been included under *P. variabile*, describing within it four varieties, the type variety being further split to encompass four forms. As well as this he described another new species, *P. microcarpum*, but this fell outside the *P. variabile* "superspecies".

No attempt seems to have been made by subsequent Australian workers to adopt Domin's concepts within the *P. variabile* complex, taxa being simply referred to *P. variabile*.

*P. tenellum*, the other Australian species, was first described by Bentham in 1868 as *Eranthemum tenellum*. It is more restricted in its distribution than *P. variabile* and with the number of collections being small, it has not attracted the same attention as *P. variabile*. It was transferred by Radlkofer to *Pseuderanthemum* in 1883.

The third species to be considered, *P. grandiflorum*, is based on Bentham's (1868) *E. variabile* var. ? *grandiflorum* from Lord Howe Island. Domin (1929) raised it to species level, but as stated in the discussion under that species (p. 144), it seems likely that the plant was either an introduction to Lord Howe Island and therefore conspecific with a cultivated Malesian species or that the collecting locality is wrong. The only specimen known is the type which has flowers and no fruits. The species is now considered to be extinct on Lord Howe Island (Rodd & Pickard 1983).

**Pseuderanthemum** Radlk., Sitzungsber. Math.-Phys. Classe Akad. Wissensch., München 13 (1883) 282; Lindau, Pflanzenfam. IV, 3b (1895) 330; Domin, Biblioth. Bot. 89 (1929) 606.

*Type species*: ? *P. alatum* (Nees) Radlk. (Mexico: but see Typification).

*Siphoneranthemum* (Oersted) O. Kuntze, Rev. Gen. Pl. 2 (1891) 494. — *Eranthemum* L. subg. *Siphoneranthemum* Oersted, Vidensk. Meddelel. no. 8-12 (1854) 166.

*Type species*: *S. fasciculatum* Oersted (Mexico).

*Eranthemum* auct. non L.: R. Br., Prodr. (1810) 477; Nees in A. DC., Prodr. 11 (1847) 445 p.p. (excluding spp. under *Grandibracteata*); Benth., Fl. Austral. 4 (1868) 555; Benth. in Benth. & Hook. f., Gen. Pl. 2 (1876) 1097; F.M. Bailey, Qld Fl. 4 (1901) 1147.

Shrubs small to medium sized, or herbs, glabrous or pubescent, with cystoliths. *Leaves* petiolate, simple, erect, each pair connected by transverse ridge. *Inflorescence* an axillary or terminal panicle or raceme with flowers arranged singly, in pairs or cymes in axils of opposite bracts spaced along rachis; cleistogamous flowers often present. *Bracts* usually 1 per flower; *bracteoles* 2 per flower at base of pedicel, small, similar in shape and size to bracts. *Calyx* segments 5, deeply divided. *Corolla* of large flowers with long slender tube, widened apically into a short throat; lobes 5, more or less equal, 2 adaxial, 2 lateral, one abaxial lobe innermost in bud; cleistogamous flowers with small, inconspicuous corollas, never opening, deciduous with development of ovary. *Stamens* 2, included or shortly exerted, inserted at top of corolla tube, anthers 2-celled, cells parallel, inserted at slightly different levels, more or less equal, without appendages; staminodes 2, small. *Disc* annular. *Ovary* with 2 ovules per cell; style long, hairy or glabrous; stigma equally bilobed. *Capsule* clavate, seedless at base, with 2 or 4 seed-bearing hooks. *Seed* orbicular, abruptly narrowed at base into short appendage, compressed, alveolate on flattened surfaces, glabrous. Fig. 22.

### Typification

In an American study Leonard (1953) designated *P. alatum* (Nees) Radlk. from Mexico as the type species of *Pseuderanthemum*, but gave no reason for his choice of lectotype. It is possible that his choice, being the first mentioned American species in Radlkofer's paper was "mechanical" and, if so, contrary to the ICBN (Art. 8). Bremekamp in "Index Nominorum Genericorum" (1979) follows this lectotypification.

However, it seems that the lectotype should be chosen from the three species studied by Radlkofer (*P. decurrens*, *P. albiflorum* and *P. bicolor*).

Leonard's subsequent (1958) change of the lectotype to *P. bicolor* (Schränk.) Radlk., after considering *Pseuderanthemum* not to have been validly published until Lindau's (1895) treatment, is to be rejected as the genus was published in Radlkofer's work.

### Distribution

There are probably 40-50 species in both the Old and New World tropics.

### Note

The genus *Pseuderanthemum* is much in need of revision throughout Malesia and the Pacific. Domin (1929) recognised the Australian species *P. variabile* as occurring outside Australia and considered a number of previously published species to deserve only varietal status within the "superspecies" (see History of the Australian species). There is no doubt that

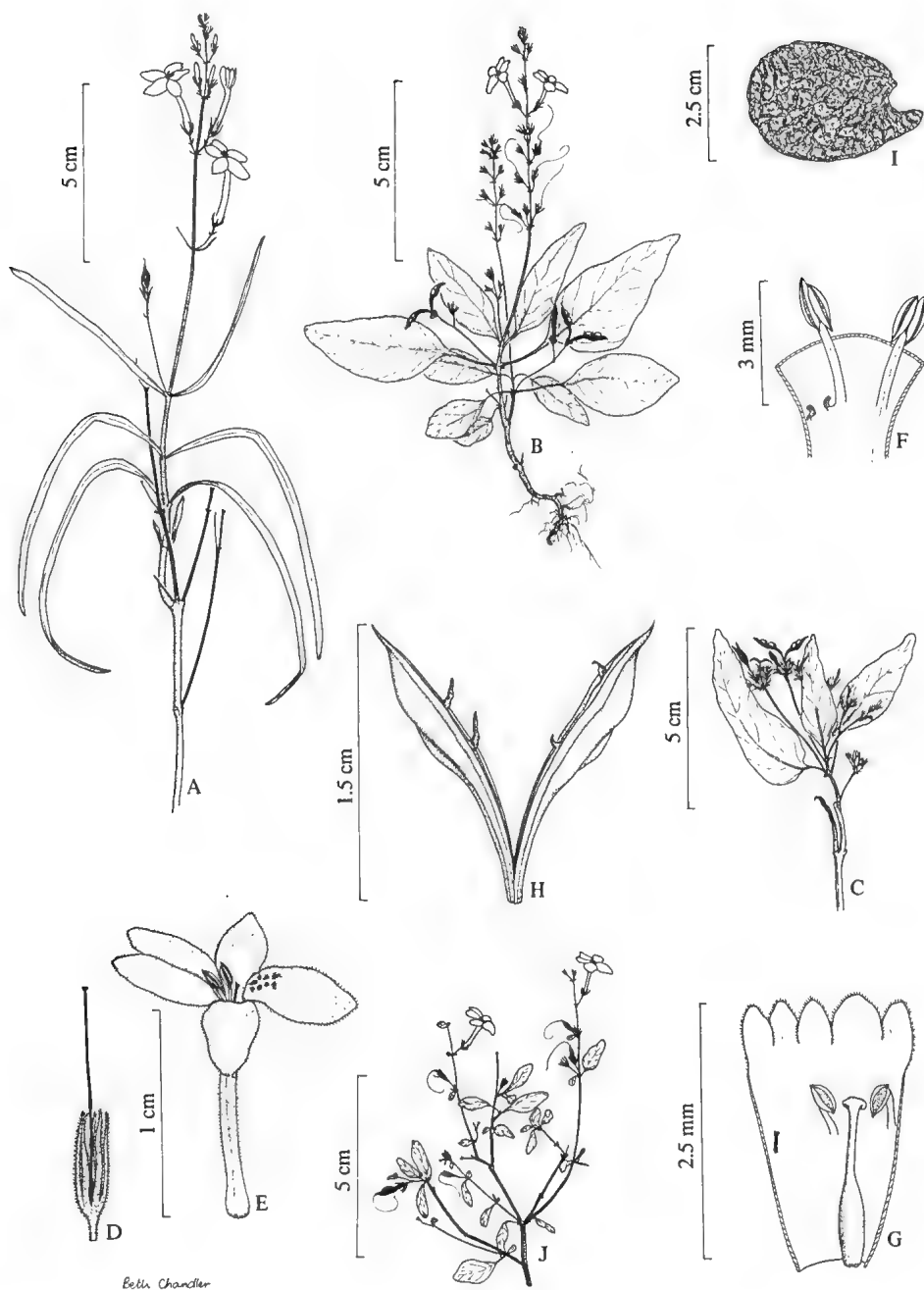


Fig. 22. A-I, *Pseuderanthemum variabile* (R. Br.) Radlk. A, linear-leaved, large-flowered form from Northern Territory. Flowers without spots. Note tiny style at apex of capsule indicating cleistogamy; B, ovate-leaved New South Wales form. Flowers with spots (Webb 5717); C, tiny-styled form with all flowers cleistogamous (Johnson MEL 564026); D, E, calyx and corolla (Webb 5717); F, stamens and staminodes at top of corolla tube (R.M. Barker 511); G, opened cleistogamous flower (Johnson MEL 564026); H, opened capsule with seed-bearing hooks, lacking seed; I, seed (R.M. Barker 511); J, *P. tenellum* (Benth.) Radlk., habit (Henderson 2625).

*P. variable* does occur in New Guinea and elsewhere in Malesia (e.g. New Caledonia, Heine 1976) but there are also a number of other species which appear to be distinct from it.

The recognition of di- and possibly trimorphic flowers on the same individual in the Australian *P. variable*, and possibly *P. tenellum*, goes some way towards improving an understanding of the variability encountered in these taxa in Australia. It may also help in an assessment of the Malesian species where, at least in New Guinea, there is a superfluity of names. Bremekamp (1957) has already documented two species from New Guinea which show yet another variation in floral structure. It may be that an understanding of the breeding systems operating within populations is a prerequisite to placing the taxonomy of Malesian species of *Pseuderanthemum* on a firm foundation.

Within Australia it was found impossible to recognise taxa within the polymorphic *P. variable*. This situation may change once the species has been studied in the field and a better understanding of the significance of the di- or trimorphic flowers is obtained.

### Key to species of *Pseuderanthemum* in Australia

- 1a. Corolla tube and throat glabrous externally, together more than 25 mm long; lobes c. 15 mm long. Pedicel c. 14-15 mm long. (Lord Howe Island) ..... 1. *P. grandiflorum*
- 1b. Corolla tube and throat pubescent externally, together less than 25 mm long; lobes 5-11 mm long. Pedicel 1-8 mm long ..... 2
- 2a. Opposite leaves unequal in size. Leaves ovate. Erect spreading shrub with white flowers, these without markings on the abaxial lobe. Flowers in short axillary racemes in the upper axils ..... 2. *P. tenellum*
- 2b. Opposite leaves equal in size. Leaves ovate, linear-lanceolate or extremely narrow-linear. Erect or creeping herb with white, pink or mauve flowers, sometimes with deep purple spots or blotches on the abaxial or anterior lobe. Flowers in terminal racemes, sometimes with clustered axillary flowers as well, rarely with the latter only ..... 3. *P. variable*

1. *Pseuderanthemum grandiflorum* (Benth.) Domin, Biblioth. Bot. 89 (1929) 607, p.p. (only as to holotype, excluding all cited varieties and forms); Rodd & Pickard, Cunninghamia 1 (1983) 278-9. — *Eranthemum variabile* R. Br. var. ? *grandiflorum* Benth. Fl. Austral. 4 (1868) 555; Oliver, Trans. Proc. N. Zeal. 49 (1917) 152.

*Holotype*: Milne s.n., s. dat. (c. 1853, Lord Howe's Island (K).

*Eranthemum variabile* auct. non R. Br.: Hemsley, Ann. Bot. 10 (1896) 247.

Woody shrub; branches furrowed, glabrous. *Leaves* in equal or unequal pairs; petioles 4-6 mm long; blade lanceolate, to 4-6 x 1-1.4 cm, base tapering, entire, apex obtuse, upper surface glabrous, small cystoliths all over, lower surface gland-dotted, glabrous. *Inflorescence* an axillary long-pedicellate flower, one per node; leaves and also ? bracts often lost. *Bracteoles* c. 1.5 mm long, triangular, sparingly pubescent. *Pedicel* c. 14-15 mm long, glabrous. *Calyx* segments c. 9 mm long, fused at base, narrow-lanceolate, glabrous. *Corolla* colour unknown; tube c. 2.8 cm long, glabrous externally, internally pubescent at least to base of filaments; lobes c. 1.5 cm long, externally glabrous, margins ciliate. *Stamens* just exerted; filaments c. 3-3.5 mm long, glabrous; anthers 2.7 mm long. *Ovary* ? glabrous; style c. 2 cm long, glabrous. *Capsule* unknown.

### Distribution

*P. grandiflorum* is known from only the one collection on Lord Howe Island.

### Ecology

Nothing is recorded or can be deduced from this collection.

## Notes

1. While the true identity of *P. grandiflorum* awaits a revision, it is possible that it could be referred to a cultivated species. Lord Howe Island was apparently unoccupied until its discovery in 1788. After this date it was often visited by whalers and there were some permanent settlers (Macgillivray 1854); it is possible that a species of *Pseuderanthemum* was introduced before Milne's visit in 1853 (Hemsley 1896). Alternatively, Mr Peter Green of Kew (pers. comm. iv.1985) suggests that Milne's collection may have been wrongly labelled with respect to locality and it may have originated from New Caledonia or New Hebrides, both calling places of this particular voyage (Macgillivray l.c.). The large flowered *Pseuderanthemum* species are apparently used extensively for personal decoration amongst Melanesian peoples.

C.B. Clarke, who worked extensively on the Acanthaceae of India, Africa and Malaya between 1885 and 1907, has annotated the type sheet of *P. grandiflorum* as *Eranthemum bicolor* Schrank, and Domin (1929), who may not have seen the type sheet, commented that it was perhaps a variety of *Pseuderanthemum pulchellum* (itself possibly a synonym of *P. bicolor*). However, *P. bicolor* has been attributed with an externally hairy corolla tube in all treatments I have seen of the species (Sims 1811, as *Justicia bicolor*; Decaisne 1834, as *Eranthemum fasciculatum*; Backer 1965), and specimens of *E. bicolor* in de Candolle's herbarium (microfiche AD) are not so long-peduncled as the Milne specimen.

The material cannot be referred to *P. variabile* as it is clearly separable from it by the size and pubescence of its corolla. Further collections from the island may help to clarify the situation, although these seem unlikely as Rodd & Pickard (1983) are of the opinion that the species has now disappeared.

2. The forms and varieties of this species referred to by Domin (1929), all belong to *P. variabile* (R. Br.) Radlk. They cannot be referred to *P. grandiflorum* as none possess such large, externally glabrous, corollas. Domin's infraspecific names have all been lectotypified under the treatment of *P. variabile*.

*Specimen examined*

LORD HOWE ISLAND: *Milne s.n.*, s. dat. (c. 1853), Lord Howe Island (K: holotype).

2. *Pseuderanthemum tenellum* (Benth.) Radlk., Sitzungsber. Math.-Phys. Classe Akad. Wissen., München 13 (1883) 287; Domin, Biblioth. Bot. 89 (1929) 608. — *Eranthemum tenellum* Benth., Fl. Austral. 4 (1868) 555; F. Muell., Syst. Census Austral. Pl. (1882) 99; F. Muell., Sec. Syst. Census Austral. Pl. (1889) 168; F.M. Bailey, Syn. Qld Fl. (1883) 369; F.M. Bailey, Cat. Qld Pl. (1890) 35; F.M. Bailey, Compr. Cat. Qld Pl. (1913) 374. — *Siphoneranthemum tenellum* (Benth.) O. Kuntze, Rev. Gen. Pl. 2 (1891) 497.

*Lectotype here designated:* [?Thozet] 404, s. dat. Rockhampton (MEL 601979); *probable isolectotypes:* (K p.p., MEL 100981); *other syntypes:* *Dallachy s.n.*, 2.xii.1867, Rockhampton (MEL 601977, K p.p.); *Bowman 153*, s. dat., Broadsound (MEL).

Small spreading shrub to 50 cm high, with short, often dense branchlets arising in axils of fallen leaves. *Branches* furrowed, glabrescent. *Leaves* at each node usually unequal, shortly petiolate; blade ovate, larger of each opposite pair to 3.5-7 cm long, often much smaller, smaller of pair c. 2-4 mm long, tapering at base, more or less entire, obtuse at apex, upper surface with cystoliths, glabrous or with a few sparse 3-4-celled eglandular hairs, lower surface without cystoliths, usually with sparse eglandular hairs, particularly on midrib and main lateral veins. *Inflorescence* short axillary racemes arising in upper axils, each with few flowers usually arranged singly or in pairs along rachis, rarely in cymes; flowers sometimes of two different

sizes at maturity (See Note 1). *Bracts* c. 1.5 mm long, subulate, with moderately dense glandular hairs on outer surface. *Bracteoles* c. 2 mm long, just exceeding pedicel, similar indumentum to bracts. *Pedicel* c. 1.8 mm long, similar indumentum to bracts. *Calyx* segments 3.8 mm long, fused at base, similar indumentum to bracts. *Corolla* white, without coloured spots; tube 9-12 mm long, externally with basal half glabrous and pubescent elsewhere, or pubescent throughout, internally pubescent in basal half; *lobes* 5.6 mm long, externally hairy, anterior lobe c. 3.6 mm long, wider than c. 2.9 mm long remaining lobes; in smaller flowers if present, corolla c. 7 mm long, tube 4 mm long, lobes 3 mm long (see Note 1). *Ovary* c. 1 mm long, glabrous initially; style c. 9.5 mm long, glabrous or with stout eglandular hairs in lower half; stigma notched at apex. *Stamens* just exerted; filaments c. 1.5 mm long; anthers 0.9-1.1 mm long, inserted at slightly unequal levels. *Disc* annular. *Capsule* 9-11 mm long, glabrous or hairy all over, with 2 seeds in each valve. *Seeds* 2-3 mm diameter. Fig. 22J.

### Typification

Bentham cites two collections in the protologue, one of Dallachy from Rockhampton and the second of Bowman from Broadsound. However, examination of the specimens reveals that some of the collections were mistakenly attributed to Dallachy when the collector was apparently Thozet. The Kew sheet which has 5 fragments on it and is attributed to Dallachy, is probably a mixture of specimens of both collectors, the far left hand specimen almost certainly being a duplicate of Thozet's MEL collection which has here been designated as the lectotype.

The collection MEL 601977, apparently made by Dallachy, has pubescent capsules, while the Thozet lectotype collection (MEL 601979) contains a number of capsules which are all glabrous. The majority of capsules present on the sheet in K are pubescent, but there is a single glabrous capsule (in the attached envelope). However, there is no way of ascertaining whether this came from the Thozet duplicate on the K sheet. The other sheet collected by Thozet which is housed in MEL is almost certainly a duplicate of the lectotype, but it was not seen by Bentham.

### Distribution

*P. tenellum* is found in eastern coastal Queensland between Tully and Brisbane. Fig. 23.

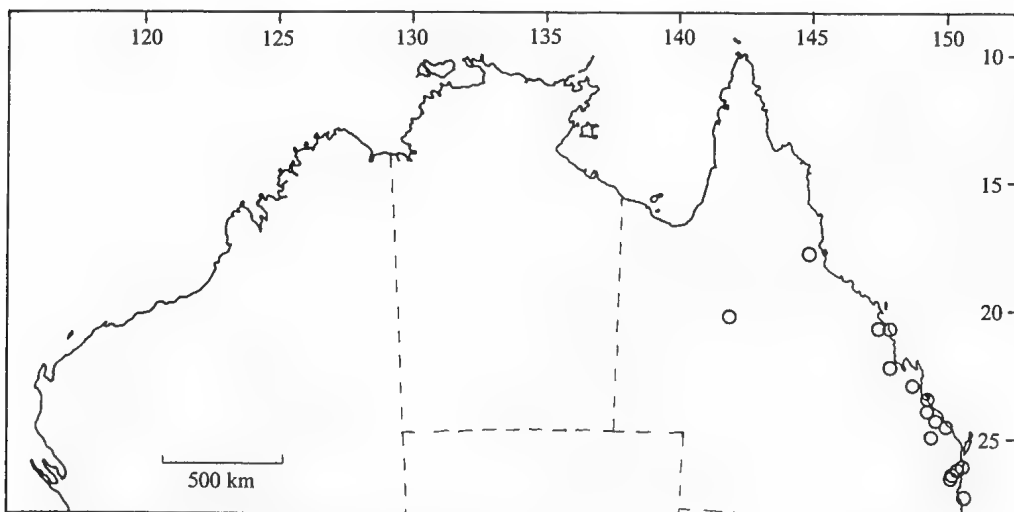


Fig. 23. Distribution of *Pseuderanthemum tenellum* in Australia.

### Ecology

Little is known of this poorly collected species. Two of the collections came from the undergrowth of rainforest-scrub on sandy loam soil. Flowering seems to occur between December and April.

### Notes

1. There is evidence on some of the collections (*Sharpe 2340*, *Clemens BRI 14331*, *White 12998*) of differences in flower size at maturity. In *P. variabile* small flowers proved to be bud-autogamous, but in this case there is no such evidence as the stigma is raised well above the anthers which are not dehiscent. It is possible that dimorphic showy flowers are produced by the species, as in *P. variabile* (q.v.: Note 1).

2. Like *P. variabile*, *P. tenellum* also shows variation in a number of characters. The corolla tube varies in hair covering from completely pubescent to pubescent in the upper half only, the style is either glabrous or hairy in the lower half, and the capsule is either glabrous or hairy all over. The small number of collections seen did not reveal any pattern which might be used as a basis for infraspecific classification.

### Specimens examined

QUEENSLAND: *Anon. (Stuart) 286*, s. dat., Moreton Bay (MEL 101061); *Anon. (Dallachy) s.n.*, 2.xii.1867, Sea View Range (MEL 601977, K p.p.); *Blake 15517 & Webb*, 12.iv.1945, near bank of Kolan R., about N of Gin Gin; *Bowman 153*, s. dat., Broomsound (MEL 601978: syntype); *Clemens s.n.*, xii.1943, Imbil? (BRI 143331); *Clemens s.n.*, iii.1944, Bunya Mts, via Kingaroy (BRI 143328); *Dietrich 561*, s. dat., Port Mackay (MEL); *Dunlop 355*, 5.iv.1969, Mt Mowbrall, Bunya Mts (NSW 124802, CBG); *Keys s.n.*, s. dat., Mt Perry, (BRI 143330); *Henderson 2625*, 1.v.1978, Glastonbury District, c. 25 km WSW of Gympie (BRI); *Nilsson s.n.*, ? iv.1920, Kingani, via Mirani (BRI 143332); *Sharpe 2340*, 30.iv.1978, Mary Creek, base of Main Range, 20 km S of Glastonbury, near Gympie (BRI); *Telford 5402*, 31.v.1977, Burnett Range, c. 2 km SSE of Mt Fort William (CBG); *Telford 5460*, 2.vi.1970, Eastern Boyne River, 24 km SSE of Calliope (CBG); ? *Thozet 404*, s. dat., Rockhampton (MEL 601979: lectotype); *Thozet s.n.*, s. dat., Rockhampton (MEL 100981, K p.p.); *Simmonds 369*, 26.i.1888, Woolston (BRI); *Shirley s.n.*, s. dat., Gladstone (BRI 143325); *Stuart s.n.*, s. dat., Moreton Bay (MEL 101057); *White 12998*, 3.iv.1949, Moreton District, Somerset Dam (BRI, NSW).

3. *Pseuderanthemum variabile* (R. Br.) Radlk., Sitzungsber. Math-Phys. Classe Akad. Wissen., München 13 (1883) 289; Lindau, Nat. Pflanzenfam. IV, 3b (1895) 330; Domin, Biblioth. Bot. 89 (1929) 606, p.p. (only as to Domin's var. *typicum*); Specht, Rec. Americ. Austral. Sci. Exped. Arnhem Land 31 (1958) 303; Beadle, Evans & Carolin, Hdbk Vasc. Pl. Sydney Dist. Blue Mts (1963) 421; Heine, Fl. Nouv. Caled. 7 (1976) 56; K. Williams, Nat. Pl. Qld (1979) 244; Jacobs & Pickard, Pl. N.S. Wales (1981) 61; J. Green, Census Vasc. Pl. W. Austral. (1981) 95, as to name only, apparently based on a misidentification: Note 3; Beadle, Evans & Carolin, Fl. Sydney Reg. 3rd ed. (1982) 506; R.J. Henderson in Carr (ed.) Sydney Parkinson, Artist of Cook's Endeavour Voyage, (1983) pl. 157. — *Eranthemum variabile* R. Br., Prodr. (1810) 477 (including,  $\alpha$ ,  $\beta$  and  $\phi$ ); Nees in A. DC., Prodr. 11 (1847) 445; F. Muell., Landsborough Explor. Austral. (1866) 118; F. Muell., Fragm. Phyt. Austral. 64 (1868) 91; Benth., Fl. Austral. 4 (1868) 555 p.p. (excluding var. ?*grandiflorum*); F. Muell., Fragm. Phyt. Austral. 9 (1875) 78; F. Muell., Fragm. Phyt. Austral. 11 (1878) 18; F. Muell., Syst. Census Austral. Pl. (1882) 99; F.M. Bailey, Syn. Qld Fl. (1883) 369; F.M. Bailey, Proc. Roy. Soc. Qld 1 (1884) 70; F. Muell., Sec. Syst. Census Austral. Pl. (1889) 168; F.M. Bailey, Catal. Pl. Qld (1890) 35; Hemsley, Ann. Bot. 10 (1896) 247; F.M. Bailey, Qld Fl. 4 (1901) 1147; F.M. Bailey in Meston, Exped. Bellenden-Ker (Parl. Rep.) (1904) 14; F.M. Bailey, Weeds & Poisonous Pl. Qld (1906) 137, f. 236; F.M. Bailey, Compr. Cat. Qld Pl. (1913) 374; Maiden & Betche, Census N.S. Wales Pl. (1916) 185. — *Siphoneranthemum variabile* (R. Br.) O. Kuntze, Rev. Gen. Pl. 2 (1891) 497.



*Syntypes*: *R. Brown s.n.*, s. dat. Port Jackson, (K p.p., MEL 601980, MEL 601981, BM: n.v.); lectotype to be chosen from amongst those specimens annotated by Brown as belonging to “*E. variabile*  $\alpha$ ”); *R. Brown 16*, 19.vii.1802, Keppel Bay (BM p.p., belonging to “*E. variabile*  $\beta$ ”); *R. Brown s.n.*, ix.1802, Shoalwater Bay (BM p.p., K p.p., belonging to “*E. variabile*  $\varphi$ ”); *R. Brown s.n.*, s. dat., North Coast (BM p.p., belonging to “*E. variabile*  $\varphi$ ”); *R. Brown s.n.*, s. dat., Arnheim North Bay (Melville Bay) (BM p.p.) not annotated by Brown as belonging to any infraspecific group; *possible syntypes*: *Banks & Solander* collections from Bustard Bay, Bay of Inlets, Endeavour’s River, Thirsty Sound, and in Java prope Anger Point (BM, n.v.): see Typification.

*Eranthemum variabile*  $\alpha$  R. Br., Prodr. (1810) 477 — *E. variabile* var. *integrifolium* Nees in A. DC., Prodr. 11 (1847) 456; substitute name, but future lectotypification will doubtless make it illegitimate: (see Typification).

*Syntypes*: *R. Brown s.n.*, s. dat., Port Jackson (BM n.v., K, MEL 601980, MEL 601981; *Cunningham 43*, s. dat., near the Brisbane River (K p.p.); *Gaudichaud s.n.*, 1830, Rawak (G — DC: microfiche AD); *Gaudichaud s.n.*, s. dat., without locality (G — DC: microfiche AD); cultivated specimen ex hort. K (G — DC: microfiche AD); *possible syntype*: *Cunningham 45*, 1829, Brisbane River (K p.p.).

*Eranthemum variabile*  $\beta$  R. Br., Prodr. (1810) 477. — *E. variabile* var. *dentatum* Nees in A. DC., Prodr. 11 (1847) 456; substitute name (see Typification).

*Lectotype here designated*: *R. Brown 16*, 10.viii.1802, Keppel Bay (BM p.p.). *Other syntype*: ? *Lambert s.n.*, 1816, New Holland (G — DC: microfiche AD).

*Eranthemum variabile*  $\varphi$  R. Br., Prodr. (1810) 477. — *E. variabile* var. *lineare* Nees in A. DC., Prodr. 11 (1847) 456, substitute name (see Typification).

*Lectotype here designated*: *R. Brown s.n.*, ix.1802, Shoalwater Bay (BM p.p.): *isolectotype*: (K p.p.); *Other syntype*: *R. Brown s.n.*, s. dat., North Coast (BM p.p.).

*Eranthemum variabile* var. *molle* Benth., Fl. Austral. 4 (1868) 555; F.M. Bailey, Syn. Qld Fl. (1883) 369; F.M. Bailey, Cat. Qld Pl. (1890) 35; F.M. Bailey, Qld Fl. 4 (1901) 1147; Maiden & Betche, Census N.S. Wales Pl. (1916) 185 (see Typification).

*Lectotype here designated*: *Dallachy 376*, 21.ii.1863, Rockhampton (MEL 601987); *isolectotype*: (MEL 601988); *possible isolectotype*: *Dallachy s.n.*, s. dat., Rockhampton (K p.p.); *Other syntype*: *Daemel s.n.*, s. dat., Cape York (MEL 601989); *possible syntype*: *Dallachy 165*, 8.i.1963, Queensland (MEL 101045).

*Eranthemum variabile* var. *lineare* Benth., Fl. Austral. 4 (1868) 555, nom. illeg., non R. Br. ex Nees (1847), F.M. Bailey, Syn. Qld Fl. (1883) 369; F.M. Bailey, Cat. Qld Pl. (1890) 35; F.M. Bailey, Qld Fl. 4 (1869) 1147 (see Typification).

*Lectotype here designated*: *Stuart 337*, s. dat., Moreton Bay (MEL 601982 p.p.); *possible isolectotype*: (MEL 601986); *other syntype*: *Mueller s.n.*, s. dat., Gilbert River (K).

*P. grandiflorum* (Benth.) Domin var. *grandiflorum* (cited as var. *typicum* by Domin) f. *normale* Domin, Biblioth. Bot. 89 (1929) 608 (not equivalent to f. *grandiflorum*: see Typification 5).

*Lectotype here designated*: *Dietrich 843*, 1863-5, Brisbane River (PR); *isolectotype*: (MEL); *other syntype*: *Domin 8441*, iii.1910, near Jericho (PR).

*P. grandiflorum* (Benth.) Domin var. *grandiflorum* f. *glabrescens* Domin, Biblioth. Bot. 89 (1929) 608.

*Lectotype here designated*: *Domin 8438*, i.1910, Picnic Hill prope deltam Russel River (PR); *Other syntypes*: *Domin 8439*, ii.1910, Castle Hill, opposite Townsville (PR); *Domin 8433*, i.1910, Cape False (PR); *Domin 8432*, iii.1910, Tamborine Mts (PR).

*P. grandiflorum* (Benth.) Domin var. *grandiflorum* f. *subrosulatum* Domin, Biblioth. Bot. 89 (1929) 608.

*Probable holotype*: *Domin 8440*, iii.1910 (see Typification).

*P. grandiflorum* (Benth.) Domin var. *longiflorum* Domin, Biblioth. Bot. 89 (1929) 608.

*Lectotype here designated*: *Dietrich 1043*, 1863-5, Brisbane River (PR); *isolectotypes*: AD, MEL, CANB.

*P. grandiflorum* (Benth.) Domin var. *pluriflorum* Domin, Biblioth. Bot. 89 (1929) 608 (see Typification).

*Syntype*: *Beckler s.n.*, s. dat., Hastings River (K p.p.); *possible isosyntypes*: (MEL 101044, MEL 101070) (see Typification).

*P. grandiflorum* (Benth.) Domin var. *perglandulosum* Domin, Biblioth. Bot. (1929) 608.

*Lectotype here designated:* Domin 8435, iii.1910, Mt Remarkable, opp. Pentland (PR); *Other syntypes:* Domin 8434, iii.1910, as for Domin 8435 (PR); Domin 8436, ii.1910, opp. Chillagoe et montes Metal Mts (PR).

*P. microcarpum* Domin, Biblioth. Bot. 89 (1929) 608.

*Probable holotype:* Domin 8433, i.1910, prope Harvey's Ck (PR) (see Typification).

*P. ultralineare* Clarke ex Domin, Biblioth. Bot. 89 (1929) 608.

*Probable holotype:* F. Mueller s.n., s. dat., Gilbert River (K) (see Typification).

*Pseuderanthemum grandiflorum* auct. non (Benth.) Domin: Domin, Biblioth. Bot. 89 (1929) 607 p.p. (as to all collections cited apart from the holotype).

Perennial herb 15-20 (-100) cm high, with creeping rhizome; branches simple erect or ascending, eglandular hairs all over. *Leaves* often jointed at base of petiole, glabrous, glabrescent or pubescent, more or less entire, apex acute or obtuse, sessile with linear blade to 12 x 0.7 cm, or petiolate and narrowly to broadly ovate, blade to 12 x 6 cm, usually smaller with attenuate base; upper surface with cystoliths obscure, lower surface sometimes purple, sometimes gland-dotted, rarely (*Wrigley & Telford NQ 1337*) with glandular hairs. *Inflorescence* a terminal spike, or raceme with opposite solitary flowers for whole length, or these confined to upper parts with opposite condensed cymes below, often with *either* axillary more or less sessile clusters, *or* long-peduncled (15-65 mm long) axillary clusters, rarely inflorescence consisting only of axillary clusters; axillary clusters often with entirely cleistogamous flowers, terminal inflorescence usually with showy flowers, or when cymose lateral flowers frequently cleistogamous. *Rachis* with glandular and eglandular hairs. *Bracts* subulate, subtending a single flower or sometimes a cyme, c. 5 mm long in lowest part of inflorescence, becoming progressively smaller higher up, similar indumentum to rachis. *Bracteoles* 2-4 mm long, inserted 1-3 mm below calyx base, similar shape and indumentum to bracts, sometimes exceeding calyx base. *Pedicel* length 1-8 mm. *Calyx* segments linear, 4-8 mm long, similar indumentum to bracts. *Corolla* of larger flowers white, lavender, lilac sometimes with darker red or purple spots on anterior lobe, tube 7-21 mm long, throat 1-2 mm long, lobes 4-11 mm long, all externally hairy with fine eglandular hairs, usually with lobes internally glabrous, rarely (in some NSW specimens) anterior lobe with sparse hairs: (see Note) tube with two rows of fine eglandular hairs; corolla of smaller flowers (but see Note 1) with tube length 2-5 mm, lobes 0.5-3 mm long, lobes externally eglandular hairy. *Stamens* of larger flower shortly exserted; filaments always glabrous, 1-2 mm long; anthers 2-celled, cells slightly unequal, slightly unequally inserted, usually very shortly mucronulate at base; stamens of cleistogamous flowers included, anthers 2-celled, one cell degenerate, cells 0.2 mm long, maturing in bud. *Disc* annular, ? absent in small flower. *Ovary* of large flower, ellipsoid, glabrous initially; style 9-20 mm long, with or without eglandular hairs in lower half, stigma just exserted; style in small flower 0.5-2.5 mm long, glabrous, stigma included, at same level as anthers. *Capsule* (7-) 12 (-22) mm long, pubescent all over or glabrous, usually with 2 well developed seed-bearing hooks per valve, sometimes 1 degenerate. *Seed* 2-3.5 mm long. Fig. 22, A-I.

### Typification

#### 1. *E. variabile* R. Br.

This species was based on the collections made by Brown and arguably, by Banks & Solander, although the latter are not referred to in the protologue.

The best represented collection of Brown (from Port Jackson) would seem obvious for choice of lectotype and corresponds to *E. variabile*  $\alpha$  of the protologue. I have not seen the BM sheet which is the likely candidate for lectotype, although duplicate sheets have been seen from K and MEL.

The type status of the Banks & Solander collections of this species is not clear. Brown

does not cite any of their material in the protologue (Brown 1810) and yet it seems he must have seen it as his own collection from Shoalwater Bay is annotated as *Justicia umbratilis* (K sheet), a manuscript name which Henderson (1983) attributes to Solander. In Brown's unpublished manuscript he refers to Banks & Solander's collections of *J. umbratilis* from "Bustard Bay, Bay of Inlets and Endeavour's R, (and) in Java prope Anger Point".

The illustration of *P. variable* by Sydney Parkinson, the artist on Banks & Solander's expedition, is identified as *J. umbratilis* from Thirsty Sound (Henderson 1983), another of Banks & Solander's collecting localities. The material upon which this was based may also have been seen by Brown. It seems that all of the collections could be considered syntype material of *E. variable* R. Br. even though they are not cited by Brown. They are considered of lesser status than Brown's own collections when choosing a lectotype.

2. The varieties of *E. variable* R. Br. recognised by Brown (1810) and named by Nees (1847).

Brown (1810) divided *E. variable* into 3 infraspecific taxa,  $\alpha$ ,  $\beta$  and  $\varphi$ , but gave them neither rank nor name. Subsequently Nees von Esenbeck (1847a) repeated the descriptions of these taxa almost word for word, naming them at varietal level. Thus Brown's  $\alpha$  became var. *integrifolium*,  $\beta$  became var. *dentatum* and  $\varphi$  var. *lineare*. Not only are the varietal names clearly derived from Brown's (1810) descriptions, being based on the terms used by Brown to describe the leaves, but in addition Nees's treatment of the taxa is almost identical to that of Brown apart from the addition of a few extra specimens, and in the case of var. *integrifolium* some additional inflorescence data.

It seems logical that Brown's specimens should be treated as syntypes since the descriptions are clearly based on them. The extra specimens seen by Nees are also considered as syntype material because some slight modifications and additions have been made to Brown's descriptions by Nees, particularly in the cases of var. *integrifolium* and to a lesser extent var. *dentatum*. The names must be considered to date from Nees (1847a) and they have here been referred to as substitute names.

a. var. *integrifolium* Nees (= *E. variable*  $\alpha$  R. Br.)

Nees (1847a) made the same citation as Robert Brown ("Ad Port Jackson et inter tropicos Novae Hollandiae"), but in addition cited *Cunningham 43* from Brisbane River, *Gaudichaud* collections from the Pisang Islands, and from Rawak Island, and cultivated material from Kew and Berlin. A lectotype cannot be chosen since the BM material of Brown's collection has not been seen. It should be noted that var. *integrifolium* is illegitimate as it contains the type of the species and hence can only be equivalent to var. *variable*.

b. var. *dentatum* Nees (= *E. variable*  $\beta$  R. Br.)

Nees again cites Robert Brown's "Inter tropicos Novae Hollandiae", but as well as this a specimen which he saw in herb. DC from Lambert and Gaudichaud. The Brown collection from Keppel Bay has been designated as lectotype. It is clearly labelled *E. variable*  $\beta$  by Brown.

c. var. *lineare* Nees (= *E. variable*  $\varphi$  R. Br.)

Nees adds no extra information to that of Brown for this taxon and it is likely that in fact he saw no material. Thus, only Brown's collections are eligible for lectotypification.

Why Brown should have described the leaves of his specimens from Shoalwater Bay and the North Coast as linear is not known as they are clearly ovate in both collections. The Shoalwater Bay collection has been selected as lectotype as it is represented by a duplicate in K.

3. *E. variabile* R. Br. var. *molle* Benth.

For his var. *molle* Benth. cites two collections, one from Cape York and the other (collected by Dallachy) from Rockhampton. However, under typical *E. variabile* he also cites Dallachy collections from Rockhampton and Rockingham Bay, and as he has not annotated specimens with their varietal name, it is unclear which material belongs to var. *molle*.

Var. *molle* is described as having "leaves rather large, ovate, thin, softly pubescent. Flowers distant in slender leafless racemes". This description applies to two sheets in MEL (both *Dallachy* 376: MEL 601987 & MEL 601988) and to a single Dallachy specimen in K which could well be of the same gathering but does not bear Dallachy's number or date. It is annotated "Rockhampton/Dallachy/F. Mueller 1868". All three collections are of equivalent condition, but the sheet MEL 601987 is the only one to have a single immature capsule present; it has accordingly been chosen as lectotype.

4. *E. variabile* R. Br. var. *lineare* Benth.

Var. *lineare* Benth. (1868) is an illegitimate name as it is predated by Nees von Esenbeck's (1847a) variety. A number of collections in MEL have been designated as types of this variety, but the description only applies to *Stuart* 337, possibly *Stuart* MEL 601986 and the Mueller collection from Gilbert River with very narrow leaves which is housed in Kew. These appear to be the only collections seen by Benth.

5. *P. grandiflorum* (Benth.) Domin — Domin's infraspecific taxa

Immediately after describing *P. grandiflorum*, Domin discusses var. *typicum* of *P. variabile* at some length and then proceeds to list a number of forms of a var. *typicum*. It might be assumed from this that the forms are referable to var. *typicum* of *P. variabile*. However, Domin's annotations on specimens and also the index in the publication (Domin 1929), makes it clear that his intentions were that these forms were referable to *P. grandiflorum* var. *typicum*. Only those taxa in which there are problems of interpretation have been discussed. *P. grandiflorum*, to the extent of Domin's typical variety (and forma) is treated as a distinct species here.

a. f. *normale* Domin

From the publication it is not clear whether Domin's concept of f. *normale* would correspond with f. *grandiflorum*. However, by definition, f. *grandiflorum* must include the Milne specimen from Lord Howe Island. Because Domin cited specimens which vary from this it has to be concluded that f. *normale* Domin was erected as a separate taxon.

b. f. *subrosulatum* Domin

It is possible that duplicates seen by Domin exist in other herbaria. The PR collection is the likely lectotype in these cases since Domin worked there.

c. var. *pluriflorum* Domin

The only specimen cited by Domin is a collection of Beckler from Hastings River. There is no material of this in his herbarium and it is likely that the material he saw is held by K. One specimen has been seen from there. However, as there may be other material in K a lectotype has not been chosen. It is likely that the two sheets in MEL are duplicates of this collection, but it is unlikely that they were seen by Domin.

6. *P. microcarpum* Domin

As with f. *subrosulatum* (see 5b above) it is possible that Domin's material is duplicated in other herbaria.

### 7. *P. ultralineare* C.B. Clarke ex Domin

C.B. Clarke in annotating a specimen at K as '*Eranthemum ultralineare*' provided the name for this species. There are other collections by Mueller of *P. variabile* from Gilbert River, but none have the extremely narrow, linear leaves of this specimen and furthermore are not annotated by Clarke. It seems likely that this is the only collection seen by Domin which is attributable to *P. ultralineare*, but a further search needs to be made at K to confirm this.

### Distribution

*P. variabile* is found throughout Queensland, in the northern part of the Northern Territory and along the eastern coast of New South Wales, as far south as Tilba Tilba, which is c. 170 km north of the Victorian border. It extends into New Guinea and is recorded as occurring in New Caledonia (Heine 1976). There is need for study of the species throughout its entire range to establish if more than one taxon may be present. Fig. 24.

### Ecology

*P. variabile* occurs in a variety of ecological habitats. For example, in Queensland it has been recorded from vine forest (Torres Strait Islands), from rainforest (Cook and North Kennedy Districts), from flooded or burnt brigalow (*Acacia harpophylla*) scrubs, or from frontal dunes in *Casuarina* woodland (Port Curtis District) and from open forest country (Burke District). New South Wales collections come from a diversity of soil types ranging from granite to sandstone. A number were recorded as being made after bushfires of the previous year.

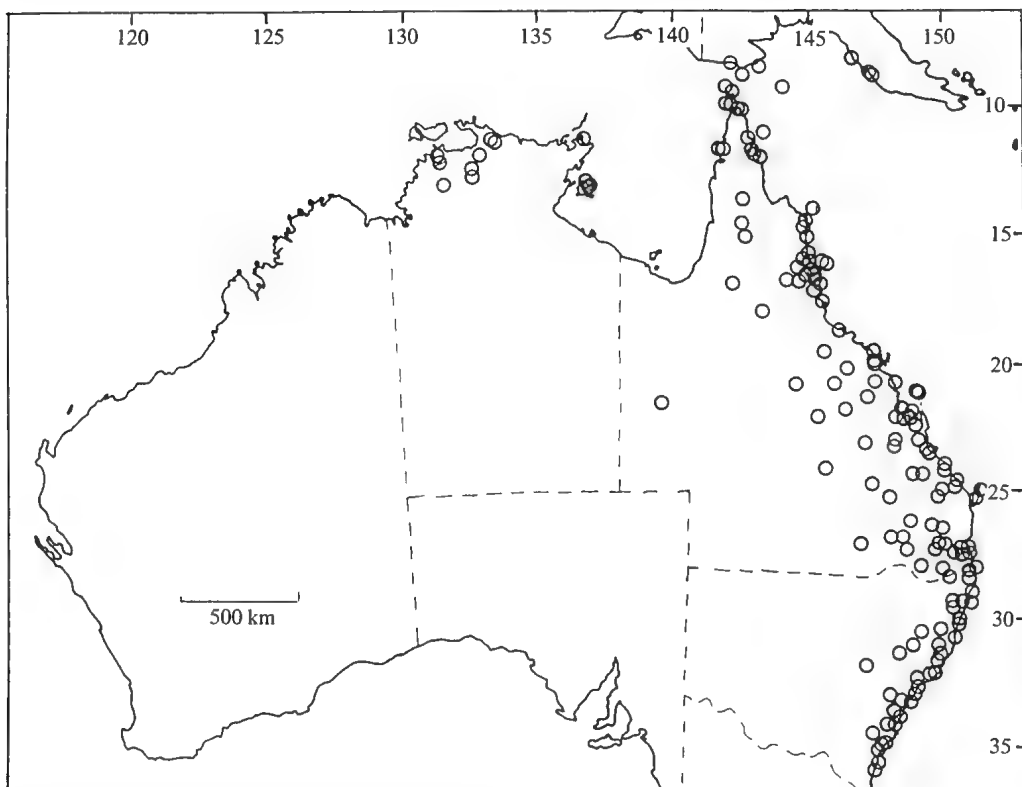


Fig. 24. Distribution of *Pseuderanthemum variabile*.

Whether or not this diversity of ecological habitat is in some way related to the polymorphism of the species can only be determined by extensive field work and a study of population variation. Flowering times in New South Wales are December to May, similar to those for Queensland specimens, although there are a few more records in the Cook District and New Guinea of later June to August flowering.

### Notes

#### 1. Variation in *P. variabile*

An initial appraisal of this species reveals a large number of what appear to be distinct taxa in Australia as Domin recognised in 1929. However, on closer analysis it is impossible to segregate these taxa as all the diagnostic characters break down. To cite one example, those specimens which might be assigned to Domin's *P. ultralineare* by their very long, narrow leaves, being found in the Northern Territory and in the Leichhardt and Moreton Districts of Queensland, showed variation in hairyness of the branches and leaves, structure of the inflorescence, size of the flower and pubescence of the capsule. These are precisely the characters which have been used in the past to distinguish taxa within *P. variabile*.

The frustrating aspect of the problem is that familiarity with the specimens makes it possible to predict where unknown specimens have been collected and one is left with the suspicion that there is a pattern to the variation in this species. The most obvious example on a broad scale are specimens from the Northern Territory and northern Queensland with their terminal inflorescences, long-tubed unspotted flowers and sessile linear leaves which are very distinct from New South Wales material with large-lobed and spotted flowers in terminal and sessile axillary clusters and petiolate, ovate leaves. Within Queensland, however, there is an intermixing of all of these characters and at this stage, without any field knowledge of New South Wales and Queensland *P. variabile*, it is preferred to treat the whole as one variable species. It is quite likely that with field knowledge these two extremes will prove to be classifiable, but whether more localised variation will be meaningful is unknown.

While most of the variability is encompassed in the description of the species, it is perhaps useful to elaborate further, particularly as allied forms attributed to *P. variabile* occur in Malesia including New Guinea, and New Caledonia.

### Leaves

These show variation in size, shape, hairyness and presence or absence of a petiole. There appears to be some tendency for the larger, ovate and petiolate leaves to be found in North Queensland with a gradual reduction in size progressing south, and similarly to find the more or less sessile, more or less lanceolate leaves in collections from the Northern Territory and adjacent areas of Queensland. The long, narrow, linear-leaved specimens appear to have no pattern to their distribution as they are found throughout the range of the species. They may be a response to dry conditions, but the lack of ecological data on the majority of specimens means that this can only be determined by field work. Similarly the suggestion that specimens which are extremely hairy (Bentham's var. *molle*) show a response to exposure could not be sufficiently tested, although they tend to be from the drier regions of Queensland (e.g. Burke and Darling Downs Districts). The Wrigley and Telford collection from the Cooktown area (Wrigley & Telford NQ 1337) is unusual in possessing glandular hairs on the undersurface of the leaves (see Note 2).

### Inflorescence

The most common form of inflorescence is a simple terminal raceme, in some cases at the lower nodes with the usual pairs of flowers replaced by opposite cymes. In addition, some specimens display one or more cymes arising on long peduncles from the upper axils and it is

commonly within these cymes that the tiny cleistogamous flowers (see later) are found. More rarely one finds sessile, axillary clusters with either no terminal inflorescence, or only a very short one. This may reflect the time of gathering of the collection (see floral biology).

### Flower

The large flowers of *P. variabile* show remarkably little variation except in size of the tube and lobes of the mature flower. These flowers, which are not as large as those of *P. grandiflorum*, usually fall into three categories, ones with the corolla tube 9-13 mm long and lobes 6-10 mm long, others with the corolla tube more than 13 mm long and the lobes less than 6 mm long, and thirdly, with the tube 7-9 mm long and the lobes 4-6 mm long. The longer-tubed flowers are generally found further north and the shorter-tubed flowers in New South Wales.

Evidence of cleistogamous flowers is found in those inflorescences which arise in the axils below the terminal inflorescence, but they are not always present. They do not appear to occur to the same extent in New South Wales populations as ones further north.

In addition to corolla size differences there is also variation in the presence of spots on the lower lobe. These are completely lacking in Northern Territory material, but seem to be present on most east coast specimens. It would be helpful if collectors documented such colouration as it is not always obvious on older dried specimens. The presence of these spots may indicate a difference in pollinator.

In some New South Wales collections (*Hoogland 11375*) the presence of spots on the anterior lobe is associated with the presence of a few sparse hairs on the same lobe. Relationships with the Javan species, *P. diversifolium* (Miq.) Radlk., in which both spots and hairs also occur, need to be investigated further.

### Style

a. *Indumentum*: The style is usually glabrous throughout, but there is a group of specimens with eglandular indumentum in the lower half. Some of these collections also have inflorescences composed solely of sessile axillary flower clusters. However in other specimens possessing hairy styles there are no such correlated characters.

b. *Length*: As well as flowers with the style of similar length to the corolla tube and reaching the same level as the anthers (but see Note 2), there frequently occurs on the same plant flowers with styles which are very short (2-3 mm long). Short-styled flowers are usually found in the sessile or, more usually, long-pedunculate cymose clusters which occur at the lower nodes of the inflorescence. Longer-styled flowers are found in the upper or terminal parts of the inflorescence. The significance of style length is discussed below under the breeding system.

### Capsule

Capsules vary in indumentum in different collections, either being completely glabrous, or with a cover of upright eglandular hairs all over. As with other characters it has been impossible to detect any pattern to this variation.

### Breeding system and floral structure

Within *P. variabile* in Australia there are often at least two types of flowers produced on the same plant. One flower type is large and showy and presumably outcrossing, the other small, inconspicuous and cleistogamous. Frequently the only means of recognizing the cleistogamous flower is the persistence of a tiny style and stigma on the capsule apex, or the presence within the calyx of a tiny ovary, style and stigma, visible only after the tiny corolla has fallen off.

Since these tiny styles persist on the apex of mature capsules containing seed the flowers from which they arose must have been pollinated within the bud before elongation of the tube and style, unless they are apomictic.

This could occur either by self pollination within the flower bud, with those flowers which are not pollinated developing into the conspicuous flower type with longer styles, or by the production of a different sort of flower entirely. A very tiny flower which is cleistogamous (pollination having obviously taken place in the bud) has been found on a number of collections (Fig. 22). The flower itself is only 3 mm long and within it is an ovary with a small (c. 1.2 mm long) style, the stigma of which is at the same level as the dehiscent anthers. Such flowers have two stamens and two staminodes, as in the large flowers, but the anthers are functionally 1-celled as one of the anther cells of each stamen does not develop fully. There are only approximately 50 pollen grains produced from each anther cell.

Since the larger flower always has two more or less equally developed anther cells which produce much greater quantities of pollen there is presumably no way in which the tiny flower can develop into the larger. Thus two different types of flower must be produced.

Cleistogamous flowers have been previously recorded for *Pseuderanthemum* (Scott 1872, as '*Eranthemum*') species in India. Within these species, Scott found "fully developed" flowers with a tube of c. 34 mm (16 lines) long, "intermediate sized" flowers with a tube of c. 10.5 mm (5 lines) long and "smallest sized" flowers with a total corolla length of 4-6 mm (2-3 lines) long. The largest flowers he found to be sterile when self-pollinated and also when crossed with pollen taken from the smaller flowers, the middle-sized flowers were found to be occasionally self-fertile but also "fairly fertile" when crossed with pollen taken from the other two flower types, while the smallest flowers were always self-fertile and considered to be cleistogamous.

*P. variable* appears to be only dimorphic and not trimorphic as cited in the case above, although it is possible that the larger flowers of the cited range for cleistogamous flowers (tube 5 mm long and lobes 3 mm long) might be better treated as "intermediate-sized" flowers. Lord (1981) in his review of the subject states that intermediate forms between the cleistogamous and chasmogamous flowers are frequent in plants exhibiting "true cleistogamy", but at this stage in *P. variable* they are not well documented.

In India, Scott (1872) found that *Pseuderanthemum* species produced large, open flowers during the cold season while in the hot season, only small, cleistogamic, self-fertile flowers were produced. In Australia it seems likely that the small, cleistogamic flowers are produced during the wet season. In the only material seen by the author in the field in the Northern Territory, the large and presumably outcrossing flowers were present in May (at the start of the dry season) with mature capsules topped by tiny stigmas already present in the lower axillary inflorescences. This observation is confirmed by an examination of dried collections. It may also help to account for the apparently reduced emphasis on cleistogamous flower production in the southern part of *P. variable*'s range (e.g. NSW) where the seasons are not so markedly "wet" and "dry" as in northern Australia.

All of these speculations need to be tested in the field before a better understanding of the breeding system of *P. variable* is achieved. With such an understanding, coupled with population studies, it may prove possible to better explain the variation encountered within the complex. Even now, knowing that *P. variable* produces at least two, and possibly three types of flowers, one can begin to anticipate the basis for variation patterns observed.

Any further study of *P. variable* should ideally include material from New Guinea and Polynesia where, according to Domin's (1929) concept, it also occurs, but as distinct varieties. Preliminary study of New Guinea material shows that it occurs there, along with a number of other taxa which seem worthy of recognition as species (see extra Australian material examined).



2. *Craven 3352* from the Rockhampton region of Queensland is a specimen which diverges from *P. variable* in its style length. In one of the almost open flowers present on the specimen the style far exceeds the anther cells in length, while in another flower of similar age the stigma is at the same level as the anthers. However in other respects it shows close affinities to *P. variable* by its cream flowers with a 19 mm long tube and 12 mm long lobes, the upper part of the tube, throat and lobes being finely eglandular hairy outside and by the glandular hairy calyx lobes.

*Wrigley & Telford NQ 1337* material from Palmer River in Queensland has glandular hairs on the undersurface of the leaves and, as in the former collection, one of the flowers present has the style longer than the stamens. In all other respects it resembles *P. variable*. The glandular hairs on the leaves are also found in *Persietz MEL 101096* and *Johnson MEL 101112*.

Investigation of more collections from these areas in respect to the whole complex may indicate that they are deserving of some taxonomic status.

3. Green's (1981) record of *P. variable* for Western Australia has apparently been based on a misidentified specimen of *Hypoestes floribunda* var. *angustifolia* (Perry 2384, PERTH duplicate).

#### *Representative specimens examined* (c. 350 specimens examined)

NEW SOUTH WALES: *Anon. 16*, s. dat. Tilba Tilba (MEL); *Constable s.n.*, 11.xii.1950, Jerrawangala State Forest, Milton-Batemans Bay (NSW 16612); *Constable s.n.*, 18.i.1952, Bulahdelah-Lake Myall Rd (NSW 19068); *Constable s.n.*, 15.xi.1952, Mt Barney, MacPherson Range (NSW 15182); *Constable s.n.*, 19.i.1953, Hat Head, Mt Korogora Pt (NSW 22213); *Constable 6348*, 17.xi.1965, Ellenborough River, 20 miles NW of Taree (NSW); *Dolling s.n.*, 19.i.1959, 4 miles N of Batemans Bay (ADW); *Hoogland 11375*, 4.ii.1968, Kiola State Forest, along road from East Lynne to Pebbly Beach, about 1 miles from East Lynne (CANB: 2 sheets).

NORTHERN TERRITORY: *R.M. Barker 511*, 9.v.1983, 14.5 km S of UDP Falls (AD); *Burbidge 5257*, 21.iv.1965, Manton River Dam, S of Darwin (CANB); *Dunlop 3240*, 16.ii.1973, East Alligator River (DNA); *Stocker s.n.*, 2.ix.1970, Gove (DNA 3178).

QUEENSLAND: *Armit 391*, s. dat. Newcastle Range and Gilbert River (MEL 100999, MEL 100103), *Bailey s.n.*, s. dat. Brisbane River (BRI 143241); *Baxter 890*, 4.v.1967, c. 3 m inland from Happy Valley on E side of Fraser Island (BRI); *Blake 15643 & Webb*, 19.iv.1945, S of Stanage Bay, NW end of Shoalwater Bay (BRI); *Blake 20207*, 20.i.1958, Cooktown, Keating's Gap (BRI); *Boylard 644*, 25.iv.1969, Mt Coot-tha (BRI); *Brass 18630*, 4.v.1948, Lockerbie, 10 miles WSW of Somerset (BRI); *Brass 19368*, 28.vi.1948, Tozer Range, north end (BRI, CANB); *Brass 19565*, 14.vii.1948, Brown's Ck, Pascoe River (CANB); *Byrnes 3733 & Clarkson*, 8.iv.1978, Junction Cherrytree and Teemburra Creeks (BRI); *Everist 1729*, 13.iii.1939, The Oaks, 20 miles W of Tara (BRI); *Fagg 690*, 22.v.1970, Shute Harbour, E of Proserpine (BRI); *Hartmann 14*, 1874, Toowoomba (MEL); *Henderson 568*, 15.iv.1971, c. 4.6 miles W of Daringin (BRI); *Henry s.n.*, 1889, Boulia (MEL 101082); *Keys 235*, s. dat. Mt Perry (BRI); *McDonald 179*, 23.ix.1971, Dipperu Nat. Pk, c. 24 km S of Nebo (BRI); *Mueller s.n.*, 1856, Moreton Bay (MEL 101018 p.p.).

For New Guinea specimens see non-Australian material.

#### Specimens examined *P. aff. variable*

QUEENSLAND: *Craven 3352*, 23.iv.1975, c. 45 km from Emerald on Rockhampton road (CANB); *Johnson s.n.*, 1891, Stuart River (MEL 101112); *Persietz s.n.*, 1877, Cooktown (MEL 101096); *Wrigley & Telford NQ 1337*, 17.vi.1972, 14 miles from Palmer River crossing along road towards Cooktown (CBG).

#### Non-Australian material of *Pseuderanthemum* examined

Type material of a number of Malesian, but particularly New Guinea, species of *Pseuderanthemum* has been seen. A preliminary look at these indicates that they do vary from *P. variable*, many of them being much larger in their floral and vegetative parts and possessing much denser inflorescences. Whether these differences would be sustained at a specific level in a Malesian revision cannot be predicted at this time, but it would appear that some at least of the New Guinea species described by Lindau (1894) and Moore (1920) are conspecific.

The species examined were as follows, but it should be pointed out that there are a number of other species named for Malesia and New Guinea which have not been seen.

1. *P. macgregorii* Lindau

NEW GUINEA: *W. MacGregor* 25, 1889, East Island, Louisiade Archipelago (MEL 1518287: isotype).

2. *P. mulleri-ferdinandi* Lindau

NEW GUINEA: *E. Bêche* 8, ?x.1881, Laughlane Islands (between New Britain and New Guinea) (MEL 1518288: isotype).

3. *P. velutinum* Lindau

NEW GUINEA: *W. MacGregor* 23, 1889, New Guinea (MEL 1518292): isotype).

4. *P. curtatum* (C.B. Clarke) Merrill

PHILIPPINES: *Borden* 2727, iii.1905, Lamao River, Mt Mariveles, Bataan Prov., Luzon (K); *McGregor* 144, iv, v.1905, Baco River, Mindoro (K); all of the following are syntypes of *Eranthemum curtatum* C.B. Clarke: *Cuming* 1658, 1841, Panay Island, (K p.p.: 2 sheets); *Merrill* 1779, iv.1903, Baco River, Mindoro (K); *Merrill* 3952, iii.1905, Mt Mariveles, Bataan Prov., Luzon (K).

5. *P. bradtkei* S. Moore

NEW GUINEA: *Bradtke* 88, iii.1917, Duke of York Islands, Bismarck Archipelago (BM, BRI: isotypes).

6. *P. armitii* S. Moore

NEW GUINEA: *W. Armit s.n.*, iii.1896, Samarai (BM, BRI: isotypes).

7. *P. confertum* S. Moore

NEW GUINEA: *C.T. White* 722, vii, viii.1918, Yule Islands (BM: isotype).

8. *P. variable* (R. Br.) Radlk.

NEW GUINEA: *Brass* 6321, iii.1936, Daru Island (LAE); *Darbyshire* 786, 9.viii.1962, 1 mile E of Delena Village, Kairuku sub-district (LAE); *Henty & Katik NGF* 38738, 11.vii.1968, Wassi Kussa River, right bank, Morehead subdistrict, Papua (LAE); *Schodde* 2558, 13.vii.1962, c. 3 miles E of Karema, Brown River (LAE); *Streimann NGF* 30823, 17.viii.1967, Edevu L(ogging) A(rea) Brown River (LAE).

## 16. GRAPTOPHYLLUM Nees

Mueller (1863) was the first to describe a species of *Graptophyllum* in Australia, but in so doing, he described it under a new genus *Earlia* which was predated by Nees von Esenbeck's (1832) *Graptophyllum*. In rectifying this, Mueller (1867) redescribed his earlier *Earlia excelsa* as *Graptophyllum earlii*, describing within it a new variety, *ilicifolium*.

Subsequently var. *ilicifolium* was raised to species level by Bentham (1868) using Mueller's manuscript name on specimens. Another species, *G. spinigerum*, was described by Mueller in 1878 and a fourth species, *G. thorogoodii*, by C.T. White in 1939.

*Graptophyllum* Nees in Wallich, *Plant. Asiat. Rar.* 3 (1832) 76, 102; Nees in A. DC., *Prodr.* 11 (1847) 327; Benth., *Fl. Austral.* 4 (1868) 551; Benth. & Hook. f., *Gen. Pl.* 2 (1876) 1118; Lindau in Engler & Prantl, *Nat. Pflanzenfam.* IV, 3b (1895) 327.

*Type species: G. hortense* Nees = *G. pictum* (L.) Griff.: origin unknown but probably somewhere in Malesia where it is cultivated.

*Earlia* F. Muell., *Fragm. Phyt. Austral.* 3 (1863) 159.

*Type species: Earlia excelsa* F. Muell. = *Graptophyllum excelsum* (F. Muell.) Druce.

Shrubs or small trees, sometimes spiny, usually with short branchlets decussately arranged along main branches. *Leaves* subsessile or petiolate, jointed at base, swollen below joint, often leathery, usually gland-dotted, with tiny cystoliths; margin entire or toothed. *Inflorescence* axillary, sessile or very shortly pedunculate clusters of 1-many pedicellate flowers, combined into leafy terminal thyrses. *Bracts* leaf-like. *Bracteoles* 2, small, at base of pedicel, usually with eglandular hairs at least on margins, sometimes with sessile glands, often shortly joined to each other at base. *Calyx* segments acute, sometimes elongating in fruit. *Corolla* deep red and conspicuous, or small and white with red spots in throat; tube widening upward into throat, curved; limb 2-lipped, upper lip shortly notched, convex, lower lip with 3 lobes of similar length, broader than upper lip, recurved. *Stamens* 2, exserted, inserted on top of tube with 2 staminodes; filaments pubescent at base; anthers 2-celled, cells parallel, equally inserted, without appendages. *Disc* annular. *Ovary* ellipsoid, glabrous, 2 ovules per cell; stigma shortly 2-lobed. *Capsule* woody, club-shaped, seedless at base, glabrous, with 2 prominent seed-bearing hooks per valve. *Seeds* flattened, with curved longitudinal grooves all over, ovate with a basal appendage on one side, glabrous. Fig. 25.

### Distribution

On current concepts *Graptophyllum* comprises about 15 species predominantly from the Pacific region and occurring in New Guinea (c. 3 spp), New Caledonia (3 spp), Fiji (3 spp.)

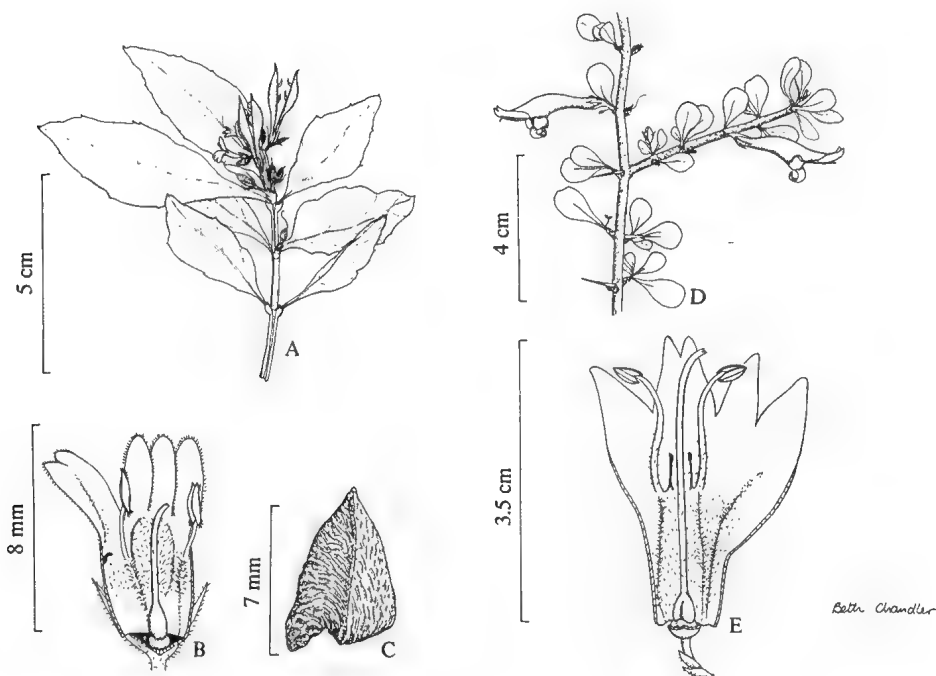


Fig. 25. *Graptophyllum*. A-C, *G. spinigerum* F. Muell. A, habit; B, opened flower; C, seed (Hyland 10911). D, *G. thorogoodii* C.T. White, partial habit (Cassels, *Flecker herb.* 14844). E, *G. excelsum* (F. Muell.) Druce, opened flower from cultivated specimen (J. Needham, Adelaide).

and China (1 sp.). Another species has also been recorded from tropical West Africa (Turrill 1912, Heine 1963). In Australia there are four species native to eastern coastal Queensland. *G. pictum* is cultivated throughout the world, presumably because of its large red-purple flowers, and is known as the "caricature plant" because of the markings on its leaves. Its occurrences throughout India, Malesia and Africa and possibly also the Torres Strait Islands of northern Australia, are probably introductions as there is some evidence that it may have originated in New Guinea (see Note 2 under *G. pictum*).

### Note

Four native species are recognised in the following treatment despite doubts that they are specifically distinct. The three large-flowered species (*G. excelsum*, *G. ilicifolium* and *G. thorogoodii*) vary in leaf characters, but the number of collections available is not sufficient to establish the full range of variation, nor to clearly establish their distribution. A possibly distinct taxon of equivalent rank from the Chillagoe area has at this stage been treated under *G. thorogoodii* q.v.: Note 1.

Further compounding the difficulties in this genus is the floral dimorphism which the three large-flowered species seem to exhibit. As well as the conspicuous large red flowers there is evidence for smaller flowers in some specimens of all three species (q.v.). Floral dimorphism has been documented in a number of species of various genera in Acanthaceae (e.g. *Dipteracanthus* and *Ruellia*) both within and outside Australia (see p. 30).

White (1939) noted that *G. thorogoodii*, one of the large flowered species, had all the vegetative characteristics of *G. spinigerum* (the only small-flowered species) and suggested that "when better known *G. spinigerum* may be found to possess more than one type of inflorescence and flower, and (*G. thorogoodii*) may have to be reduced to a synonym or at most to a variety". This statement is possibly correct but it can be taken further. We are perhaps dealing with a single variable species, encompassing all four presently recognised taxa, or alternatively *G. spinigerum* is distinct and the three large-flowered taxa represent a single species approaching *G. pictum*. The importance of such characters as presence or absence of spines, leaf shape and size, flower size and shape, as well as the floral biology of the species needs to be carefully analyzed.

Further collections and observations on floral characteristics and population variation would be much appreciated by the author.

### Key to species of *Graptophyllum* in Australia

- 1a. Flowers small, the corolla 7.0-8.5 mm long, white with red spots in the throat. Anthers with a few hairs on apex and base. (Plant often with axillary spines in older parts; inflorescence a very dense axillary cluster)..... 1. *G. spinigerum*
- 1b. Flowers large, the corolla more than 2.5 cm long, red. Anthers glabrous .....2
- 2a. Leaves more than 5 cm long, 3-10.5 cm broad .....3
- 2b. Leaves up to 4 x 1.5 cm .....4
- 3a. Leaves prickly-toothed, with 2-7 spines along margin, apically with a sharp mucro, not variegated. (Australia) ..... 3. *G. ilicifolium*
- 3b. Leaves entire with undulate margin, not prickly-toothed, apically acute or acuminate, sometimes variegated. (Plants often cultivated, Malesia, New Guinea, Torres Strait Islands) ..... 5. *G. cf. pictum*
- 4a. Axillary spines present. Largest leaves 1.4-1.9 cm long, usually with very short pubescence at the base on the very short petiole and the midrib of the lower surface (hand lens) ..... 4. *G. thorogoodii*
- 4b. Axillary spines absent. Largest leaves 2.5-4 cm long, entirely glabrous ..... 2. *G. excelsum*

1. ***Graptophyllum spinigerum*** F. Muell., *Fragm. Phyt. Austral.* 11 (1878) 17; F. Muell., *Syst. Census Austral. Pl.* (1882) 99; F. Muell., *Sec. Syst. Census Austral. Pl.*, (1889) 168; F.M. Bailey, *Qld Fl.* 4 (1901) 1152; F.M. Bailey, *Compr. Cat. Qld Pl.* (1913) 375, f. 354.

*Lectotype here designated: Persietz 126, 1877, Cooktown (MEL 100761); possible syntype: Persietz s.n., s. dat. Endeavour River (MEL 100765): see Typification.*

Shrub 1-2 m high, glabrescent; branches with hairs either all over or in 4 rows along angles, often with 1-3 axillary spines to 1.5 cm long in older parts. *Leaves* subsessile, more or less elliptic to ovate, 1-8 x 0.7-3.8 cm, leathery, shining, glabrous, narrow attenuate at base, margin with 1-7 teeth, usually in upper half, acute and sometimes spine-tipped at apex. *Inflorescences* small, dense, axillary clusters of cymes, each flower subtended by pair of tiny bracteoles at base of pedicel. *Bracteoles* tiny, 0.4 mm long, triangular, covered with eglandular hairs. *Pedicel* 0.5-1.5 mm long, elongating in fruit. *Calyx* segments 3.3-5.5 mm long, elongating to 6-6.5 mm in fruit; outer surface with short eglandular hairs all over, more dense towards apex, sometimes with sessile glands on margins of segments and inner surface. *Corolla* 7.5-8.5 mm long (in Australia, to 15 mm long in New Guinea specimens), white with red spots in throat (from specimen annotations) or ?red (fide Bailey 1901), externally covered with short eglandular hairs (in Australia, glabrous in New Guinea), internally glabrous except for hairs at point of filament insertion; tube and throat combined 4.5-5.5 mm long. *Stamens*: filaments glabrous; anther cells with few hairs at base and apex, connective extended shortly above them. *Ovary*: style glabrous or with a few sparse hairs. *Capsule* 15-20 mm long. Fig. 25 A-C.

### Typification

The only specimen cited by Mueller in his original description of this species was that of Persietz from Endeavour River. There are four collections in MEL made by Persietz from Cooktown or Endeavour River, but as two of these (*Persietz 115, 121*) were made in 1881 and Mueller's description was published in 1878, these cannot be considered for lectotypification. Of the other specimens, *Persietz s.n. MEL 100765* and *Persietz 126 MEL 100761*, only the latter bears a date, 1877, and this is also annotated '*Graptophyllum spinigerum* FvM' in Mueller's hand, while the other has no such annotation. Thus, *Persietz 126* is designated as lectotype of this species. The other sheet is possibly a syntype but agrees more with the two later collected specimens.

The collection *Persietz 115* has on one of the packets contained in the envelope, the annotation '*Graptophyllum spinigerum* var' in Mueller's hand. Its characteristics are discussed under Note 2.

### Distribution

*Graptophyllum spinigerum* is known from a series of sporadic records along the eastern coast of Queensland, from the rivers of the McIlwraith Range in northern Queensland, through the Cooktown area further south, to Eumundi in the Brisbane area. The most commonly collected species, it is still only represented by about 20 specimens in Australian herbaria. It is also found in New Guinea (see Note 2). Fig. 26.

### Ecology

In Australia the species is recorded from 70-300 m altitude, mainly from rainforest with other collections coming from semi-deciduous vine forest with emergent *Bombax ceiba* or emergent *Melaleuca argentea* and *M. leucadendron*. In New Guinea it has been collected in the foothills fringing mangroves (*Pullen 3683*) and as an undergrowth species in steep hillside forest (*Pullen 1154*).

### Notes

1. As already stated there is doubt about the distinctness of *G. spinigerum*. Vegetatively it resembles *G. thorogoodii* by the presence of axillary spines in the older parts, but the leaves are

usually larger in *G. spinigerum*. Some of the larger leaved specimens (e.g. Hyland 9449) are almost indistinguishable vegetatively from specimens which have been referred to *G. ilicifolium* (Jones 2068 and Thozet MEL 100759). It is possible that the smaller flowers which appear to be present with other *Graptophyllum* species (see Note 2) in Australia are equivalent to the flowers of *G. spinigerum*. However, all annotations on specimens indicate that the flowers of *G. spinigerum* are white with red spots (Clarkson 2363, fide Hyland and New Guinea specimens) compared with the usual deep red-purple throughout the other species. In addition the anther cells of the flowers of *G. spinigerum* differ from those of the larger flowers by being pubescent. On the present evidence maintenance at species level seems justified, but further investigations are required.

2. *G. spinigerum* as constituted here is somewhat variable. New Guinea specimens tend to have larger flowers than those found on specimens in Australia. They are still not as large as flowers found in the other species of *Graptophyllum* found in Australia. More study is needed to establish if differences in flower size between Australian and New Guinea populations are of any taxonomic significance.

In addition there is a certain amount of variation between collections in Australia. Mueller recognised this in annotating one of the envelopes on the sheet, *Persietz 115* from Cooktown as '*Graptophyllum spinigerum* var.'. This annotation might also be referred to the collections *Persietz 121*, *Persietz s.n. MEL 100765* and *Flecker N.Q. Naturalist Club 13287*. In all cases the specimens have more densely clustered inflorescences with the flowers and capsules on shorter pedicels than usual. These collections also lack spines, although this is not necessarily significant as they are frequently lacking in other collections. The small number of collections and insufficient information on the development of the pedicel and calyx in fruit has led to all of the collections being treated as one species here.

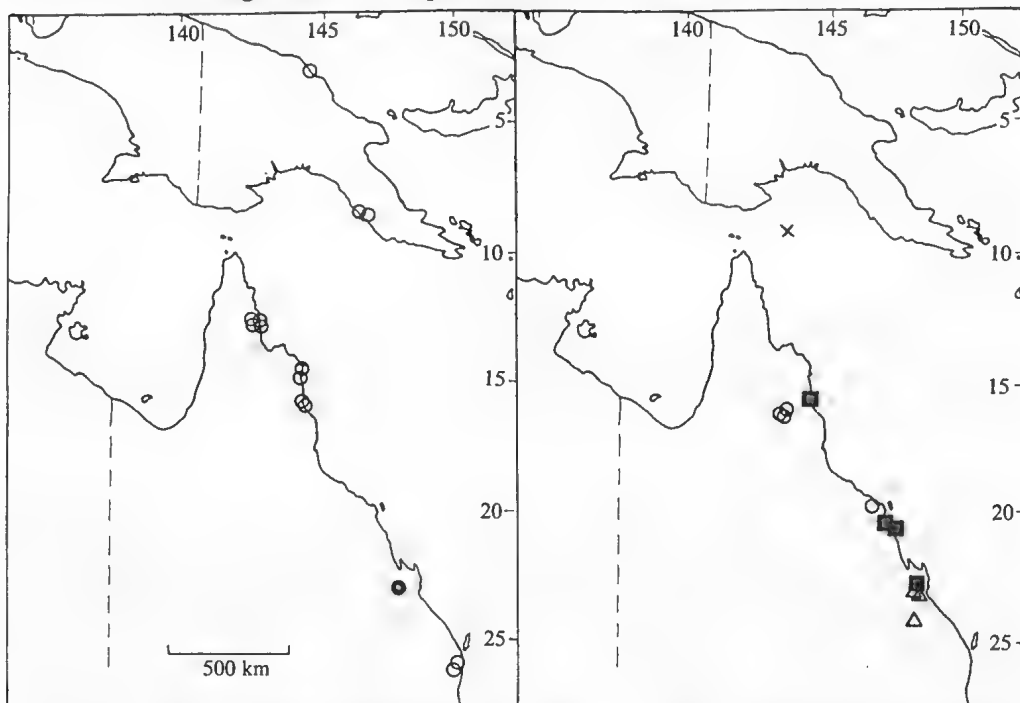


Fig. 26. Distribution of *Graptophyllum spinigerum* ○ in Australia and New Guinea. Specimen with affinities to *G. spinigerum* ●.

Fig. 27 Distribution of *Graptophyllum thorogoodii* ○, *G. excelsum* Δ, *G. ilicifolium* ■ and *G. aff. pictum* × (Murray Islands).

*Specimens examined*

QUEENSLAND: *Anon. s.n.*, 1892, Eumundi (MEL 100762); *Bailey s.n.*, xi.1900, Eumundi (BRI 138921); *Brass 1944*, 16.i.1932, Mowbray River (BRI, K); *Clarkson 2363*, 24.vii.1978, Leo Ck, upstream from falls. On eastern fall of Mollwraith Range (BRI, QRS); *Field Naturalists s.n.*, xi.1892, Eumundi (BRI); *Flecker (N Qld Nat. Club 13287)*, 19.vii.1949, Mt White, near Coen (BRI, K, QRS); *Francis s.n.*, s. dat., Kin Kin (BRI 138924); *Francis & White s.n.*, iii.1916, Kin Kin (BRI 138925, NSW 51870); *Hyland 6801*, 4.ix.1973, T.R. 14 (Rocky River) (BRI, CANB, K, QRS: 2 sheets, NSW); *Hyland 8022*, 14.ii.1975, Near Koombal Pk (BRI, QRS); *Hyland 9449*, 25.vii.1977, Chester River (QRS); *Hyland 10911*, 11.xi.1980, T.R. 14 Massy (QRS); *Persietz s.n.*, s. dat., Endeavour River (MEL 100765); *Persietz 115*, 1881, Endeavour River (MEL); *Persietz 121*, 1881, Endeavour River (MEL); *Persietz 126*, 1877, Cooktown (MEL: lectotype); *Webb & Tracey 9971*, x.1969, Peach Ck Crossing on Coen-Leo Ck Rd, c. 30 m NE of Coen (BRI, K); *Webb & Tracey 11879*, vi.1973, Dowlings Hill on Mt Amos Rd, south of Cooktown (BRI).

PAPUA NEW GUINEA: *Pullen 1154*, 25.ix.1958, Lower Ramu-Atitau Area, ½ m S of Bari village, Sakula valley, Madang District, Bogia sub-district (LAE); *Pullen 3683*, 29.ix.1962, Abandoned site of Hedoa, at head of Galley Reach, Central District Port Moresby sub-district (LAE); *Schodde 2630*, 24.vii.1962, c. 3 miles W of Mt Lawes, Central District (LAE).

Specimens aff. *G. spinigerum*

QUEENSLAND: *Webb & Tracey 10446A*, x.1969, Rundle Range State Forest, c. 12 km SE Port Alma near O'Connor Ck which joins Fitzroy R near its mouth (BRI).

2. ***Graptophyllum excelsum*** (F. Muell.) Druce, Bot. Exch. Club Brit. Isles, Report 1916, 4 (1917) 625; S.G.A.P.-Townsville, Austral. Pl. 8 (1975) 97, 134; K. Williams, Native Pl., Qld 1 (1979) 132, pl. — *Earlia excelsa* F. Muell., Fragm. Phyt. Austral. 3 (1863) 160. — *Graptophyllum earlii* F. Muell., Fragm. Phyt. Austral. 6 (1867) 87; Benth., Fl. Austral. 4 (1868) 551; F. Muell., Syst. Census Austral. Pl. (1882) 99; F. Muell., Sec. Syst. Census Austral. Pl. (1889) 168; F.M. Bailey, Qld Fl. 4 (1901) 1153; F.M. Bailey, Compr. Cat. Qld Pl. (1913) 375, fig. 352. — *Thyrsacanthus earlii* F. Muell., Fragm. Phyt. Austral. 6 (1867) 87, pro syn.; Benth., Fl. Austral. 4 (1868) 551, pro syn.; F.M. Bailey, Qld Fl. (1901) 1153, pro syn.

*Lectotype here designated: Thozet 75*, s. dat., Rockhampton (MEL 601936); *Syntypes: Anon. s.n.*, s. dat., Rockhampton (MEL 100764); *Anon. [Dallachy] s.n.*, s. dat., Fitzroy River (K). *Possible syntypes: Thozet 23*, s. dat., Rockhampton (MEL); *Dallachy s.n.*, s. dat., Fitzroy River (MEL 601932); *Dallachy s.n.*, s. dat., Rockhampton (MEL 100756, K); *Dallachy s.n.*, 13.i.1863, Frenchman's Creek (MEL 601933, 601934, 601935); *Dallachy 113*, 2.i.1863, Frenchman's Creek; *Dallachy s.n.*, 2.i.1863 & 14.i.1863, Frenchman's Creek; *Anon. [Dallachy or Thozet] s.n.*, s. dat., Rockhampton (MEL 100753, 100754, 100755).

Shrub to 3 m high, 1 m diameter; branches in younger parts with line of eglandular hairs along each angle, glabrous in older parts, often with short crowded, decussate branchlets along length of main axes; axillary spines absent. *Leaves* more or less obovate, or lanceolate, to 2.5-4.0 x 0.8-1.5 cm, leathery, shiny above, duller below and gland-dotted, glabrous with margin entire or more usually with 2-3 tiny teeth either side of and towards apex; acute or obtuse at apex and with short mucro. *Inflorescences* axillary clusters of 1-4 flowers, sessile or very shortly pedunculate. *Bracteoles* 1.2-2 mm long, short eglandular hairs on margin and midrib externally, internally usually with sessile glands. *Pedicel* 3-4 mm long, glabrous, ? not elongating in fruit. *Calyx* segments 3-7 mm long, ?not elongating in fruit, glabrous on outer surface except for sparse eglandular hairs at apex, sometimes with sessile glands on inner surface. *Corolla* c. 28-30 mm long, blood-red or red-purple, tube c. 10 mm long, throat c. 10 mm long, 3.5-5.5 mm broad; upper lip 7-10 mm long; lower lobes c. 9 mm long; outer surface glabrous except for few eglandular hairs along margins of lobes and inner surface, shortly pubescent throughout tube and throat. *Stamens*: filaments with sparse hairs; anther cells glabrous, connective not extended past the apex. *Ovary*: style with sparse eglandular hairs throughout length. *Capsule* 17-27 mm long. *Seed* 3-5 mm diameter. Fig. 25E.

### Typification

Mueller's original description of *Earlia excelsa* was based on collections by Dallachy and Thozet from "in silvis densis montanis ad flumen Fitzroy". There are eleven such sheets in MEL and two in K, variously labelled as coming from Fitzroy River, nearby Rockhampton (the majority) and Frenchman's Creek. All must qualify for consideration in selecting a lectotype, but only two MEL sheets, *Anon. MEL 100764* and *Thozet 75* and a single K sheet, bear the inscription "*Earlia excelsa*" by Mueller. Of these, the Thozet collection has been chosen as lectotype; it is by far the best material with its several flowers as well as seeds and mature capsules.

All other sheets may be syntypes of *Earlia excelsa*. They are all annotated with the later name '*Graptophyllum Earlei*' by Mueller. Their use in drawing up his original description of the species is questionable, particularly as a number of the collections were made in January 1863, while the publication appeared in April 1863. The others bear no dates, nor do they have collectors names.

### Distribution

*Graptophyllum excelsum* is known only from Fitzroy River and Frenchman's Creek near Rockhampton. It has not been collected since the 1860's and there must be some doubt whether this species still exists in its natural state. However, Williams' (1979) illustration of the species was taken "from a cultivated plant originally taken from the Rockhampton district", possibly implying that the species still exists there. All other collections seen were from shrubs cultivated in Brisbane and Sydney Botanic Gardens and Brisbane University. The species appears to be quite widely cultivated in the eastern States. Fig. 27.

### Ecology

Nothing is recorded on specimens of the requirements for this species, but Wrigley & Fagg (1979) note that for cultivation it performs best in heavy to medium shade in well composted soil, while Williams (1979) records it as growing (?naturally) "on rough, eroded hillsides where the soils are derived from weathered limestone. These hillsides are quite steep and the plants are found in the pockets of soil among the rocks and crevices".

### Note

Dallachy (*MEL 601933*) expected cuttings of *G. excelsum* to be easy to take "as it throws its roots from the old wood like a vine in a moist climate". The ease of cutting has certainly been the case in Adelaide where Mr J. Needham has successfully grown the plant by this means. The species seems to be capable of self pollination as a single specimen growing in Mr Needham's garden has flowered and produced mature capsules, although the seed has not been tested for viability. The large amount of nectar produced in the base of the flowers and their brilliant red colour presumably attract birds as pollinators.

### Specimens examined

QUEENSLAND: *Anon. (Dallachy or Thozet) s.n., s. dat.,* Rockhampton (*MEL 100753, MEL 100755, MEL 100764*); *Bailey s.n., s. dat.,* Rockhampton (*BRI 138966*); *Dallachy s.n., s. dat.,* Fitzroy River (*MEL 601932, K*); *Dallachy s.n., s. dat.,* Rockhampton (*MEL 100756*); *Dallachy s.n., 2, 13 & 14, i.1863,* Frenchman's Creek (*MEL 601933, MEL 601934, MEL 601935*); *Tenison-Woods s.n., s. dat,* Rockhampton (*MEL 100757*); *Thozet 23, s. dat.,* Rockhampton (*MEL*); *Thozet 75, s. dat.,* Rockhampton (*MEL*: lectotype of *Earlia excelsa*).

CULTIVATED MATERIAL: NEW SOUTH WALES: *Boorman s.n., xi.1907,* Botanic Gdns, Sydney (NSW 151894); *Rodd s.n., 15.x.1965,* Royal Botanic Gdns, Sydney (NSW 79223). QUEENSLAND: *Anon s.n., 1.x.1898,* Botanic Gdns, Brisbane, (*MEL 100758*); *Anon. s.n., ix.1874,* Specimen from Mr Hocking's Nursery (*BRI 138964*); *Blake 2032, 30.x.1930,* University, George St, Brisbane (*BRI*); *Blake 2799, x.1931,* Botanic Gdns, Brisbane (*BRI*); *Caulfield & Marien in Blake 23567, 12.xi.1970,* Botanic Gdns, Brisbane (*BRI*); *White 9245, 9.ix.1933,* Botanic Gdns, Brisbane (*BRI*). VICTORIA: *Kaspiew 1526, 5.x.1957,* Melbourne (B).



3. **Graptophyllum ilicifolium** (F. Muell.) F. Muell. ex Benth., Fl. Austral. 4 (1868) 552; F. Muell., Syst. Census Austral. Pl. (1882) 99; F. Muell., Sec. Syst. Census Austral. Pl. (1889) 168; F.M. Bailey, Qld Fl. 4 (1901) 1153; F.M. Bailey, Compr. Cat. Qld Pl. (1913) 375, f. 353. *G. earlii* F. Muell. var. *ilicifolium* F. Muell., Fragm. Phyt. Austral. 6 (1867) 87, BASIONYM.

*Lectotype here designated: Nernst s.n.*, s. dat. Port Mackay, Mount Blackwood (MEL 601937); *isolectotype*: (MEL 601938); *possible syntypes or isoelectotypes*: *Anon. 13*, s. dat., Mount Blackwood (MEL); *Nernst s.n.*, s. dat. Mount Blackwood (K).

Shrub 3-4.5 m high; branches with large prickly leaves when young, when old with smaller, less prickly leaves (approaching *G. excelsum* in shape); axillary spines absent. *Leaves* subsessile, ovate, to 5.5-11.5 x 3-6 cm, very leathery, shiny, glabrous, attenuate at base, margin with 2-7 sharp spines along either side, sharp mucro at apex. *Inflorescence* clusters of c. 4-6 flowers per axil, rarely as many as 10. *Bracteoles* 2-4 mm long, those of opposite pairs sometimes shortly fused at base, dense, lax hairs on margin, sometimes (*Anon. BRI 138912*, *Thozet MEL 100759*, *Thozet 626*) with sessile glands all over or on inner surface only. *Pedice* 2.5-7 mm long, glabrous. *Calyx* segments 5-9 mm long, ?elongating to c. 15 mm with development of capsule, with sparse eglandular hairs along midrib and at apex. *Corolla* 28-31 (-35) mm long, blood-red, tube and throat combined 20-23 mm long, throat 2.5-3.5 mm broad, lobes c. 8-10 mm long, outer surface glabrous, inner surface pubescent in the tube, glabrous elsewhere. *Stamens*: filaments with sparse hairs; anther cells glabrous, connective not extended past apex. *Ovary*: style glabrous. *Capsule* c. 28 mm long.

### Typification

There are two sheets in MEL collected by Nernst from Rockhampton and both would qualify for selection as lectotype. *MEL 601938* bears the annotation in Mueller's hand, 'Graptophyllum Earlei Ferd. Mueller var. *ilicifolia*', while *MEL 601937* is annotated 'Graptophyllum (Earlia) *ilicifolium*' on the label, together with the annotation 'Graptophyllum *ilicifolium*, Earlia excelsa var. *ilicifolia*' on the packet in the envelope. The latter was obviously the basis for Bentham raising 'ilicifolia' to species level and attributing it to Mueller. As both sheets were available to Mueller in drawing up his protologue, *MEL 601937* has been chosen as lectotype on the basis that it is the better material; it contains flowers, mature capsules and seed, while the other sheet has only a single flower.

*Anon. 13* is possibly a syntype as it was collected from Mount Blackwood, which is the locality cited on the lectotype. The sheet bears neither date, nor collector's name and bears the annotation of the later combination 'G. *ilicifolium*'. However, it was seen by Bentham and attributed to Nernst by him (Bentham 1868) along with the other two Nernst collections. The Nernst sheet in K bears no annotation except *Graptophyllum ilicifolium* and so was probably not used in drawing up the description of *G. earlii* var. *ilicifolium*.

### Distribution

*Graptophyllum ilicifolium* is known only from the central Queensland coast by three old collections from the Mackay district and two old collections from Rockhampton. Collections by Jones from further north at Port Douglas, made in 1961, approach this species. (see Note 3). Fig. 27.

### Ecology

Nothing is known of its ecological requirements apart from a single note 'rocky places' on *Anon. 13* from Mt Blackwood.

## Notes

1. *G. excelsum* and *G. ilicifolium* are very similar. While they differ in leaf size and shape, with other possible differences in calyx length, flower size and possibly shape and capsule size, the small sample size for both species, particularly for *G. ilicifolium*, cannot rule out the possibility they are merely variants of the one species. *Thozet MEL 100759* possesses much smaller leaves with fewer spines than the rest of the sample of *G. ilicifolium* and thus approaches *G. excelsum*. The comment that the large leaves are found on young parts and smaller leaves on older parts (*Thozet 626*) may also indicate a high phenotypic plasticity in these plants. Future collections may show that the 'holly leaves' of *G. ilicifolium* may be more appropriately treated at Mueller's (1867) original varietal status under *G. excelsum*.

2. The Nernst collections exhibit great elongation of the calyx segments with the development of the fruit, a characteristic also seen in some material of *G. spinigerum*. As the remaining collections of *G. ilicifolium* lack capsules the diagnostic importance of this character is in need of confirmation.

3. Two collections made by Jones (*BRI 030207*, *Jones 2068*) from Port Douglas agree with *G. ilicifolium* in leaf size and shape, but have only small flowers present. A number of other specimens, while possessing the larger flowers of typical *G. ilicifolium*, also show evidence for the presence of smaller flowers. Thus dimorphic flowers may occur in this species as it seems they do in other Australian species. As already discussed under *G. spinigerum* (Note 1), it may prove with further investigation that the taxa involved are not specifically distinct. The collections by Jones could equally well be treated as *G. spinigerum*, because of their small flowers.

## Specimens examined

QUEENSLAND: *Anon. s.n.*, s. dat., Without locality (MEL 602041 p.p.: mounted with *Holtze 270* (*Acanthus ilicifolius*) and presumably a fragment from one of the specimens cited here); *Anon. (Nernst?) 13*, s. dat., Mount Blackwood, Coast Range, Mackay District (MEL 601939); *Nernst s.n.*, s. dat., Mount Blackwood, Port Mackay (MEL 601937; lectotype; MEL 601938, isotype); *?Niejerat 64*, s. dat., Mackay (BRI 146579); *Thozet s.n.*, 1873, Rockhampton (MEL 100759); *Thozet 626*, s. dat., Rockhampton (MEL).

CULTIVATED: QUEENSLAND: *Anon s.n.*, s. dat. Bowen Park, Brisbane (BRI 1389111, BRI 138912).

Specimens either *G. ilicifolium* or *G. spinigerum*

QUEENSLAND: *Jones s.n.*, vii.1961, Port Douglas beach (BRI 1030207); *Jones 2068*, 22.vii.1961, Port Douglas (CANB).

4. *Graptophyllum thorogoodii* C.T. White, Proc. Royal Soc. Qld 50 (1939) 83.

*Holotype: Thorogood 1*, iii.1937, Kelsey Creek, near Proserpine (BRI).

Shrub or small tree to 2 m tall, many-stemmed; branches slender, sometimes drooping, with short, often dense, decussately arranged branchlets, young parts with single pair of opposite leaves per node, later up to 5-6 leaves in cluster at each node through development of short shoots, nodes often with a spine, with short, moderately dense, upright, eglandular hairs in young parts, glabrescent. *Leaves* subsessile, elliptic to orbicular, 1.3-1.9 (-2.5) x 0.5-1.0 cm, dull, glabrous except for sparse, very short eglandular hairs on very short petiole, sometimes on midrib and margins of lower surface, base attenuate, margin entire or with 1-2 very short teeth, apex obtuse, sometimes with small mucro at apex. *Inflorescences* axillary, solitary or clusters of 2-3 flowers, sessile or shortly pedunculate. *Bracteoles* 0.5 mm long, fused to each other for half length, sometimes with sessile glands and short eglandular hairs. *Pedicel* 2.8-3.5 mm long, rarely (on type) 6-10 mm, glabrous or with similar indumentum to bracts at base. *Calyx*

segments 2.5-5.5 mm long, rarely (on type) 7.5-9 mm, ?not elongating in fruit, glabrous on outer surface apart from sparse tiny hairs on margins and midrib, sessile glands on the inner surface. *Corolla* c. 30-35 mm long, red to vivid purplish-red, outer surface glabrous, inner surface with pubescent tube and base of lower lobes, tube and throat combined c. 20 mm long, throat 2.5-5 mm broad, tube bent at point of stamen insertion, upper and lower lips equal, c. 10 mm long. *Stamens*: filaments pubescent in lower half, glabrous above; anthers glabrous; connective not extended. *Ovary*: style glabrous. *Capsules* not seen. Fig. 25D.

### Distribution

*Graptophyllum thorogoodii* is known from only two regions in north Queensland, from the Mungana-Chillagoe area, the source of most collections, and from the Proserpine area, which is represented only by the type. There is reason to consider that the collections from the two regions may represent two distinct taxa. Fig. 27.

### Ecology

The collections from Mungana Caves are from deciduous vine thicket, while those from Chillagoe are from limestone bluffs.

### Note

1. The collections from Chillagoe and the Mungana Caves are distinct from type material from Proserpine, c. 600 km to the south-east. They are much woodier, more spinescent, have their leaves in clusters of 5-6 at each node and have shorter pedicels and calyces than the type. They have not been formally separated from *G. thorogoodii*, however, because of the lack of collections and the need for field work.

Compounding this problem, as with the other species, there is some evidence in the collections that two flower types may be present. In some collections there are not only the more obvious large flowers with their correspondingly long style, but also what appear to be some smaller flowers with shorter styles.

### Specimens examined

QUEENSLAND: *Cassels* (*Flecker Herb.* 14884), xii.1967, Chillagoe (BRI, QRS); *Hinton s.n.*, iii.1968, Chillagoe (BRI 079150); *Nicholson* 4113, 28.vii.1967, Chillagoe (K); *Stephens* (*Flecker Herb.* 11845), 28.x.1974, Ghost Cave, Mungana (BRI, QRS); *Thorogood* 1, iii.1937, Kelsey Creek, near Proserpine (BRI; holotype); *Whaite* 3, 14.viii.1979, Arch at Mungana Caves area (QRS).

5. *Graptophyllum* aff. *pictum* (L.) Griff., Notul. Pl. Asiat. 4 (1854) 139. — *Justicia picta* L., Sp. Pl. ed.2, 1 (1762) 21.

*Type*: *Anon. s.n.*, s. dat. Asia Herb. Linn. 28.5 (LINN).

*G. hortense* Nees in Wallich, Pl. Asiat. Rar. 3 (1832) 102; Nees in A. DC., Prodr. 11 (1847) 328: nom. illeg.

Shrub or small tree to 3 m high; branches glabrous, no spines in axils. *Leaves* with petioles 3-10 mm long, blade oblong to lanceolate, 6-20 x 3-10.5 cm, somewhat shiny, sometimes variegated, glabrous at base, margin undulate, apex acuminate. *Inflorescences* terminal or axillary ?racemes with decussately arranged pedicellate flowers, subtended by bract and pair of bracteoles, sometimes subtending reduced cymes. *Bracts* and *bracteoles* c. 3-4 mm long. *Pedicel* 5 mm long, glabrous. *Calyx* segments 6.5-7 mm long, glabrous apart from short eglandular hairs on margins. *Corolla* c. 4 cm long, red, tube 2-2.5 cm long, glabrous externally; upper lip c. 1.5-2 cm long, ?glandular internally; lower lobes narrow, 1.5-2 cm long, glandular. *Stamens*: filaments glabrous; anther cells glabrous, connective shortly extended past their apex. *Capsule* and seed not seen.

*Distribution*

*G. pictum* is known in Australia from a single collection from Murray Island in Torres Strait. It is cultivated throughout the world. Its origin is unknown, but may be New Guinea (Note 2). Fig. 27.

*Ecology*

Nothing is recorded for the Australian occurrence of *G. pictum*. In New Guinea at least it has been recorded from logged-over forest and rain-forest undergrowth and is often grown as an ornamental or as a hedge plant around villages. The leaves are also used as a vegetable (Powell 1976).

*Notes*

1. The majority of the c. 20 New Guinea specimens examined appear to be *G. pictum*. The genus, however, is in need of revision there. As well as *G. pictum* being recorded from New Guinea, there are two other species described, *G. pubiflorum* S. Moore and *G. gilliganii* F.M. Bailey. From descriptions, *G. pubiflorum* should be distinct from *G. pictum* by its white, externally glandular corollas and pilose style, while *G. gilliganii* is described as having minute glandular teeth on the margins of the leaves and so should be distinctive by this characteristic.

The single Australian specimen is in poor condition, but fits well enough with *G. pictum* from New Guinea.

2. Bremekamp (fide Backer 1965) claimed that the pollen was always sterile in specimens grown in Java and so the plant could only be grown by cuttings, but it is unlikely that this is the case in New Guinea. Here, in addition to specimens from around villages, its forest occurrences are likely to be spontaneous rather than cultivated. In support of this are occasional mature capsules and seed present on the collections. The fact that it does appear to occur spontaneously in New Guinea coupled with the production of capsules and seed lends support to the contention that the species originated there (Bailey 1949).

3. The three large-flowered species of *Graptophyllum* in Australia all approach *G. pictum* in floral characteristics, but the flowers are smaller and possibly broader. Nothing has been recorded in any of the literature to indicate that *G. pictum* possesses dimorphic flowers.

*Specimens examined*

QUEENSLAND: Lawrie 68, vii.1970, Murray Island (BRI).

## 17. XEROTHAMNELLA C.T. White

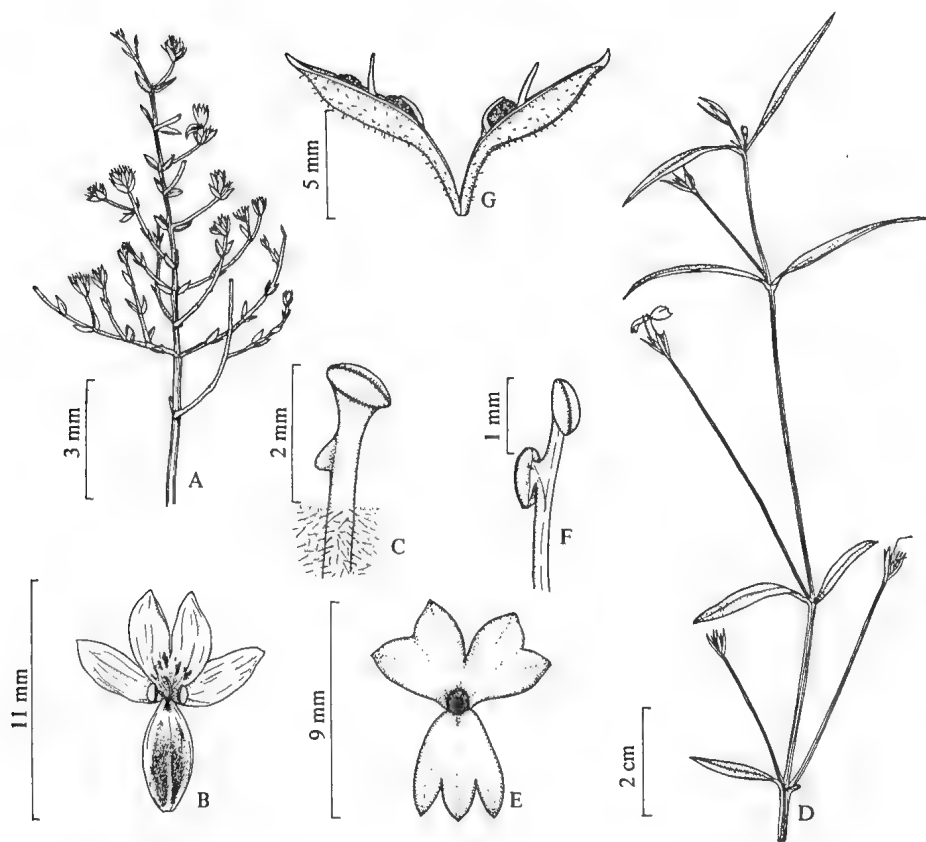
*Xerothamnella* was first described by C.T. White in 1944 as a monotypic genus from the drier areas of southern Queensland. A second species, from brigalow areas near Chinchilla, has been added here.

*Xerothamnella* C.T. White, Proc. Royal Soc. Qld 55 (1944) 72; W.R. Barker in Jessop, Fl. Central Austral. (1981) 337; Jacobs & Pickard, Pl. N.S. Wales (1981) 61.

*Type species*: *X. parvifolia* C.T. White (Australia).

Low shrubs or herbs, with cystoliths; branches angled. *Leaves* sessile or shortly petiolate, jointed at base, with transverse ridge between opposite pairs. *Inflorescence* usually arising in both axils of node, a long peduncle with terminal cluster of 2-6 subsessile flowers at different

stages of development in axils of bracts and bracteoles. *Bracts* and *bracteoles* usually slightly larger than calyx. *Calyx* with 5 linear or lanceolate lobes. *Corolla* tubular at base, limb 2-lipped; upper lip wider than lower lip, with 4 entire lobes or 2 erect, emarginate lobes, lower lip 1 or 3-lobed, lobes entire. *Stamens* 2, inserted at top of tube; anthers 2-celled with one terminal transverse cell and second parallel cell below and to one side, or 1-celled with terminal cell only present and second cell completely lacking or present by a bump. *Disc* annular. *Ovary* with 2 superposed ovules per cell; style glabrous or hairy, stigma clavate, notched. *Capsule* club-shaped, solid at base, usually with 2 conspicuous, seed-bearing hooks in expanded part of each valve. *Seed* discoid, glabrous, smooth-tuberculate all over. Fig. 28.



Beth Chandler

Fig. 28. *Xerothamnella*. A-C, *X. parvifolia* C.T. White. A, habit (Bäuerlen 294); B, front view of flower (W.R. Barker 4854); C, stamen showing attachment to corolla tube, remnant of second anther cell and apical transverse cell (W.R. Barker 4854). D-G, *X. herbacea* R.M. Barker. D, habit; E, front view of flower (stylised from dried material); F, stamen with anther cells; G, open capsule with seed-bearing hooks and seed (Hando AD 98407213).

### Distribution

*Xerothamnella* is an Australian genus confined to southern Queensland and northern New South Wales. It consists of only 2 species.

### Note

*Xerothamnella* and the endemic Western Australian genus *Dicladantha* appear to be related, agreeing in inflorescence, capsule and seed morphology. They differ, however, in the shape of the corolla (regular vs 2-lipped) and the arrangement of the anther cells. The anther cell arrangement within the 4 species involved could have been derived from each other, but this is speculation. Anther cell arrangements approaching those in *Xerothamnella* are found in some American *Justicia* species (Long 1970, fig. 5m).

### Key to species of *Xerothamnella*

- 1a. Low woody shrub. Leaves sessile, ovate, 0.4-1.0 x 0.2-0.3 cm. Lower corolla lip entire. Capsule glabrous. Anthers 1-celled, the vestige of a lower second cell sometimes represented by a bump ..... 1. *X. parvifolia*
- 1b. Decumbent herb. Leaves usually shortly petiolate, linear to ovate, 1-3.5 x 0.3-1 cm. Lower corolla lip 3-lobed. Capsule glandular hairy. Anthers with 2 cells, the lower cell parallel to filament ..... 2. *X. herbacea*

1. *Xerothamnella parvifolia* C.T. White, Proc. Royal Soc. Qld 55 (1944) 72; W.R. Barker in Jessop, Fl. Central Austral. (1981) 337; Jacobs & Pickard, Pl. N.S. Wales (1981) 61.

*Holotype*: White 12052, 1.iv.1941, Dynevor Downs (BRI); *isotypes*: (MEL, K: 2 sheets).

Sparse, low woody shrub, to 1 m high; branches angled, longitudinally furrowed, with short appressed eglandular hairs. *Leaves* sessile, ovate, 4-10 x 2-3 mm. *Corolla* tube 4.5 mm long, sparsely hairy outside, pubescent internally especially along ridges below insertions of filaments; upper lip 4 lobed, lobes 5-5.5 mm long, internally glabrous, white with red spots at base, externally white, pubescent on lower half; lower lip entire, glabrous, blood-red inside, glabrous, white outside. *Stamens*: filaments glabrous; anthers 1-celled, cell apical and dehiscing by transverse slit (i.e. perpendicular to filament), sometimes with remnant of second cell present as bump below apical cell. *Ovary* glabrous or with a few hairs at apex; style pubescent in basal 1/2-2/3. *Capsule* 7-8.5 mm long, glabrous; seed-bearing hooks 1-2 per valve. *Seed* 1-2 per valve, c. 3 mm diameter. Fig. 28 A-C.

### Distribution

*X. parvifolia* is confined to southern central Queensland, with a single old collection from north-western New South Wales. Fig. 29.

### Ecology

*X. parvifolia* has been recorded chiefly from *Acacia cambagei* low open woodland with a (Purdie 2080) *Cassia oligophylla* and *Cassia nemophila* understory. Purdie 2080 & 2081 were both from reddish clays with a gravel surface. The species is locally common, but must be regarded as rare. Its flowering time cannot be gauged with any certainty, although the holotype and Purdie collections were made in April and these have flowers and mature seeds present. The Barker and Chinnoek collections on the other hand were made in October during a good year and so flowering is probably dependent on rainfall.

### Specimens examined

NEW SOUTH WALES: *Bauerlen* 294, s. dat., Mt Poole (MEL, NSW).

QUEENSLAND: *W.R. Barker 4787, Chinnock & Ballingall*, 22.ix.1984, Gowan Range, c. 8½ km direct SW of Lorne Peake: Unnamed hill, c. 6 km by road SSE of Mt Calder homestead, c. 2½ km SW of Red Mountain (AD); *W.R. Barker 4825 & 4826*, 24.ix.1984, Grey Range, 84 km by road WNW of Thargomindah, 39 km direct E of Nockatunga, c. 300 m S of road (AD); *W.R. Barker 4854*, 25.ix.1984, c. ½ km by road S of turnoff to The Castles, c. 7½ km by road SSW of the Yowah Opal Field store, on road to Black Gate Opal Field (AD); *Chinnock 6235*, 24.x.1984, 84.1 km NW of Thargomindah on hill c. 1 km N of road (AD); *Chinnock 6271*, 25.x.1984, 16.4 km NE of the Thargomindah-Eulo road on the Black Gate Opal Mine-Yowah road (AD); *Everist & Smith 48*, 7.i.1937, Wittenburra Station, c. 36 miles S of Eulo (BRI); *Hill s.n.*, 1956, "Navarra and Creswick", 45 miles from Yaraka, 100 miles S of Longreach, 100 miles W of Blackall (NSW 151871); *Pike s.n.*, ii.1971, Wittenburra Stn (BRI); *Purdie 714*, 20.vii.1977, Grey Range, c. 82 km from Thargomindah along road to Noccundra (BRI); *Purdie 2080*, 10.iv.1984, Gowan Range, about 11 km approx. SW of "Highlands" homestead (CBG); *Purdie 2081*, 10.iv.1984, Gowan Range, Mt Remarkable area; about 27 km approx. SE of Yaraka (CBG); *Smith 323*, 31.v.1955, Boatman Road (BRI); *White 12052*, 1.iv.1941, Dynevor Downs (BRI, holotype; K, MEL).

## 2. *Xerothamnella herbacea* R.M. Barker, sp. nov.

Species nova, a *X. parvifolia* differt foliis petiolatis, herbaceis, 1-3.5 x 0.3-1 cm, corolla infero labio trilobato et supero labio bilobato, capsulis pilos glandulosos gerentibus, staminibus supero loculo transverso et infero loculo ad filamentum parallelo.

*Holotype*: *Hando s.n.*, 4.ii.1984, Pelican Back Road, off Chinchilla-Wondai Rd (Burnett Highway) (AD 98407213); *isotype*: to be distributed.

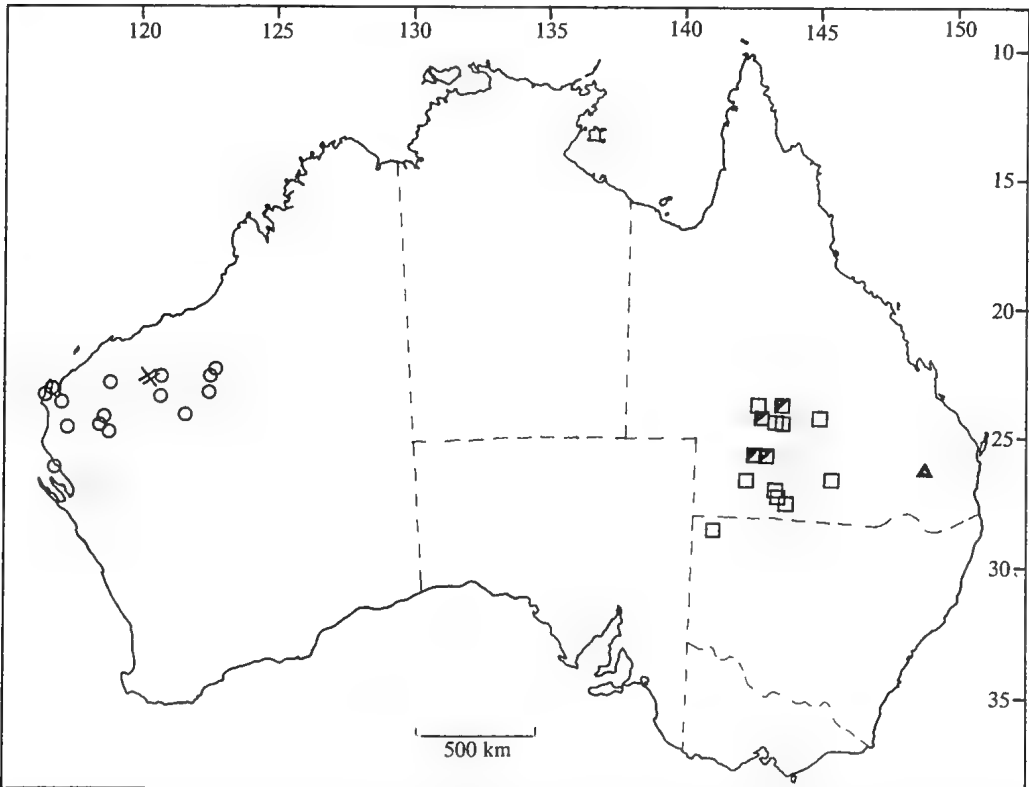


Fig. 29. Distribution of the endemic Australian genera *Xerothamnella* and *Dicladanthera* (○ *Dicladanthera forrestii*; × *D. glabra*; ▲ *Xerothamnella herbacea*; □ *X. parvifolia*; ■ *X. parvifolia* sightings by R. Purdie (pers. comm.))

Decumbent herb, to 30 cm high, rooting at lowest nodes. *Branches* angled, longitudinally furrowed, glabrous. *Leaves* with petioles to 1.5 mm long, blade linear to ovate, 1-3.5 x 0.3-1 cm, glabrous, darker green above, paler below; upper surface with dot-like glands. *Inflorescence* usually paired, 0.5-6 cm long peduncles arising in axils of upper leaves, these peduncles terminating in cluster of 3-6 flowers at different stages of development, each flower with 2 bracteoles and 2 bracts. *Bracts* and *bracteoles* linear, glandular hairy, slightly larger than calyx. *Calyx* 4 mm long, with mixture of glandular and eglandular hairs; lobes linear. *Corolla* tube 6.5 mm long, externally white, with eglandular hairs, lips pink to mauve, upper lip 3.5 mm long, wider than lower lip, 2-lobed, appearing 4-lobed by deeply emarginate lobes, lower lip 3.5 mm long, with 3 entire lobes, glabrous. *Stamens*: filaments 3 mm long, pubescent at point of attachment 3 mm above base of tube and in lower half; anthers with 2 cells, inserted at unequal levels, apical cell with transverse dehiscence, lower cell inserted 0.5 mm below apical cell, sessile, vertical dehiscence. *Ovary* glandular hairy; style glabrous except for sparse hairs at very base, 5 mm long. *Capsule* c. 9 mm long, sparsely glandular hairy, seed-bearing hooks 2 per valve. *Seed* 2 per valve. Fig. 28 D-G.

### Distribution

*X. herbacea* is known only by 2 collections, both by Mrs V. Hando, from the Chinchilla area of Queensland (Fig. 29).

### Ecology

Mrs Hando (pers. comm. 9.ii.1984) records the species as growing "in a shady position under brigalow trees (*Acacia harpophylla*) where the almost bare ground was littered with phyllodes". Both specimens have flowers.

### Notes

1. I am indebted to Mrs Hando of Chinchilla for extra collections of this species. The only collection seen initially was sufficient to indicate a new taxon, possibly a new genus, but insufficient for taxonomic description. Mrs Hando rectified this almost immediately with a collection which has now been designated the holotype. As well as this she supplied habit drawings of the plant and its flower which aided greatly in placing the species within *Xerothamnella*. All her correspondence and illustrations have been attached to the holotype.

2. The two species of *Xerothamnella* are very different in habit, *X. parvifolia* being a low woody shrub with small leaves and *X. herbacea* being a non woody, decumbent perennial with linear, herbaceous leaves. However, in the arrangement of their inflorescence they are the same (and also similar to *Dicladanthera*). The flower of *X. parvifolia* may be a derivative of the sort seen in *X. herbacea*. Thus in the corolla, the upper lip of *X. herbacea* is intermediate between the normal 2-lobed state found in the majority of Acanthaceae and the unusual 4-lobed condition of *X. parvifolia*; the entire lower lip of *X. parvifolia* derives from the more usual (and hence primitive?) 3-lobed state seen in *X. herbacea*. In addition, the stamens of *X. parvifolia* are clearly a derivative of *X. herbacea*, the lower anther cell of the former usually being evident as a vestigial bump.

3. *X. herbacea* is very similar to *Rostellularia adscendens* ssp. *adscendens* in habit and flower colour, and the two are found in the same area. They are easily distinguished by their inflorescence arrangements (terminal spike in *Rostellularia*, long pedunculate clusters arising from the axils in *Xerothamnella*), their anther arrangement (those of *Rostellularia* are unequally inserted, but the lower cell has a long white appendage and the apical cell is not transversely inserted) and flower shape (the upper lip of *Rostellularia* flowers is narrower than the lower lip, the lower lip also possessing a barred palate).



*Specimens examined*

QUEENSLAND: *Hando 131*, 3.i.1980. 32 km NE of Chinchilla (BRI); *Hando s.n.*, 4.ii.1984. Pelican Back Rd, off Chinchilla-Wondai Rd (Burnett Hwy). (AD 98407213: holotype; isotype to be distributed).

**18. DICLADANTHERA F. Muell.**

This endemic Australian genus was first described by Mueller in 1882 (Mueller 1882c) when he described *D. forrestii* from Western Australia. It is unique in the family in Australia because of its stamen structure and cannot be satisfactorily placed in the present tribal and subtribal divisions of the family (see p. 8). Lindau (1895) placed it in subtribe Odontoneminae, but it has been treated here, together with *Xerothamnella*, as a genus of uncertain subtribal placement. A second species from Western Australia is newly described here.

**Dicladanthera** F. Muell., *Fragm. Phyt. Austral.* 12 (1882) 23; Lindau in Engler & Prantl, *Nat. Pflanzenfam.* IV, 3b (1895) 335, 339.

*Type species: D. forrestii* F. Muell. (Australia).

Spreading herbs or subshrubs, with cystoliths; branches 6-angled. *Leaves* sessile or shortly petiolate, each of opposite pair connected by transverse ridge. *Inflorescence* an axillary, long-pedunculate group of 1-5 flowers at different developmental stages, subtended by 2 free outer bracts; each flower with 2-5 free bracteoles similar to outer bracts. *Calyx* shorter than bracts and bracteoles, lobes 5, thinner than bracts and bracteoles, free almost to base, rarely 2 fused for  $\frac{1}{4}$ - $\frac{3}{4}$  of length. *Corolla* regular, with short, narrow tube about ovary, widening into much larger throat, 5 equal, spreading lobes; outer surface with eglandular hairs, inner surface glabrous except for pubescence in lower half of tube. *Stamens* 2, placed on opposite side of corolla to style; filaments inserted at top of throat with long rib decurrent below, short, extending to top of throat, divided at apex into U-shaped connective perpendicular to filament, two parallel arms each terminated by anther cell; anther cells not spurred, glabrous, sutures apical. *Disc* annular. *Ovary* with 2 superposed ovules per cell, glabrous; style glabrous or hairy; stigma capitate or forked. *Capsule* clavate, 2 prominent seed-bearing hooks in upper half of each valve. *Seeds* discoid, glabrous, smoothly tuberculate. Fig. 30.

*Distribution*

This is an Australian genus restricted to the area between the Hamersley Ranges and Carnarvon in north western Western Australia.

**Key to the species of *Dicladanthera***

- 1a. Leaves linear, sessile, glabrous. Bracts and bracteoles glabrous. Corolla with tube and throat together 15.5-22 mm long. Style glabrous. Capsule glabrous..... 1. *D. glabra*
- 1b. Leaves ovate, petiolate, glabrous or hairy. Bracts and bracteoles with dense glandular pubescence. Corolla with tube and throat together 8-14 mm long. Style pubescent, at least in lower half. Capsule pubescent..... 2. *D. forrestii*

**1. *Dicladanthera glabra* R.M. Barker, sp. nov.**

Species nova, a *D. forrestii* differt foliis linearibus, glabris, sessilibus, bractis bracteolisque glabris, floribus magnis, stylo glabro et capsulis glabris.

*Holotype: Demarz 2828*, 30.x.1970, Wittenoom Gorge (PERTH); isotype: (KINGS PARK).

Low spreading herb to 50-60 cm (rarely 80-100 cm) tall, glabrous in all parts. *Leaves* sessile, narrow linear, largest to 24-47 x 1-3 mm, glabrous; base attenuate, margin entire, apex acute. *Peduncle* 1.2-4.5 cm long, glabrous. *Bracts* and *bracteoles* usually similar in size and shape, narrowly deltoid, 9-11 mm long, glabrous, rarely bracts smaller than bracteoles, 5 mm long. *Calyx* lobes slightly shorter and narrower than bracteoles, sometimes with 2 lobes fused for most of their length, other lobes free, glabrous. *Corolla* white or bluish-white; tube and throat together 15.5-22 cm long; lobes 7-14 mm long. *Style* glabrous, 14-17 mm long; stigma capitate 13-15 mm long. *Capsule* (only 2 seen) glabrous, ?2-seeded. *Seed* 2-2.5 mm long, as for *D. forrestii*. Fig. 30 E, F.

### Distribution

*D. glabra* is known from only a few collections from two locations, Wittenoom Gorge and Robe River which are in the Fortescue River watershed of the Pilbara region of north western Western Australia. Fig. 29.



Fig. 30. *Dicladanthera*. A-D, *D. forrestii* F. Muell. A; habit (Davis 62); B, opened flower; C, stamen as it appears in dried material — in life the anthers are curved into a U-shape as in F (Hutchinson 116); D, opened capsule with seed-bearing hooks and seed (Davis 62). E-F, *D. glabra* R.M. Barker. E, habit; F, stamen (McGuire 24).

### Ecology

The only ecological annotation on the collections is a reference to "iron rich alluvial soil".

### Note

I am indebted to Mrs E. Hall of Wittenoom for extra collections, comments and photographs of this new species of *Dicladanthera*. She records the plant (in litt. to B. Maslin, PERTH) as very common and found it growing in Bee Gorge, Cathedral Pool and Little Gorge in the Wittenoom area.

### Specimens examined

WESTERN AUSTRALIA: *Blockley* 253, 25.iv.1966, Fortescue/Wittenoom Gorge (KINGS PARK, PERTH); *Butler* 42, 27.viii.1966, Robe R, between Onslow and Roebourne (PERTH); *Demarz* 2828, 30.x.1970, Wittenoom Gorge (KINGS PARK, PERTH); *Fairall & Lullfitz* L 2737, 21.x.1963, 4 miles short of Wittenoom Line (PERTH); *Hall* s.n., 25.iv.1983, Wittenoom Gorge (AD 98328001); *Hall* s.n., 13.v.1982, Cathedral Pool in Wittenoom Gorge (AD 98309153); *McGuire* 24, i.1972, Wittenoom (PERTH); *Willis* s.n., 15.viii.1974, Mouth of Bee Gorge, c. 6 miles west of Wittenoom (MEL).

2. *Dicladanthera forrestii* F. Muell., *Fragm. Phyt. Austral.* 12: (1882) 23; F. Muell., *Sec. Syst. Census Austral. Pl.* (1889) 168; Gardner, *Enum. Pl. Austral. Occid.* (1931) 119; Beard, *Descr. Cat. W. Austral. Pl.* 2nd edn (1970) 119; *Census Vasc. Pl. W. Austral.* (1981) 95.

*Lectotype here designated: Forrest* s.n., 1882, Menilyalya River, north of Shark Bay (MEL 601760); *isolectotypes:* (MEL 601759, K).

"*Justicia kempeana* var." F. Muell., *Fragm. Phyt. Austral.* 11 (1880) 101, p.p. (as to Giles MEL 60200).

Much-branched straggly perennial herb or subshrub to 50 cm high, ?viscid (*Royce 1516*); basal branches crowded at apex of perennial rootstock, spreading, decussate lateral branches higher up, eglandular hairy on young parts, glabrescent. *Leaves* subsessile, or shortly and broadly petiolate, petiole 1-4.5 mm long; blade ovate, largest to 12-40 x 6-22 mm, base truncate, or more rarely shortly attenuate, margin undulate, apex acute or obtuse; sometimes with eglandular hairs all over or confined to petiole, midrib, margins and main lateral veins, sometimes with glabrescent short glandular pubescence on young leaves, sometimes glabrous. *Peduncle* 0.9-5.3 cm long, glabrous or with eglandular hairs scattered towards base, more dense and often mixed with small glandular hairs towards apex. *Bracts* linear-lanceolate, 7-13 mm long, with dense mixture of short, conspicuously glandular hairs and shorter hairs topped by smaller ?glands. *Bracteoles* 9-15 mm long, similar to but narrower than bracts, often exceeding them, with similar indumentum. *Calyx* lobes shorter and narrower than bracteoles and with similar indumentum. *Corolla* white, pink or pinkish-blue; tube and throat together 8.2-14 mm long; lobes 4.5-10 mm long. *Style* with sparse eglandular hairs, 9-13 mm long; stigma forked. *Capsule* 10-13 mm long, glandular and eglandular hairs all over, 4-seeded. *Seed* 3 x 2.5 mm, densely tuberculate, pale around circumference, centre darker with occasional pale patches. Fig. 30 A-D.

### Typification

Mueller's original description of this species refers only to Forrest's collections from Menilyalya (Minilya) River, north of Shark Bay. There are two sheets in MEL and one in K which qualify for selection as lectotype of the species. MEL 601759 is only a single fragment of *D. forrestii* while the K material is two fragments. However, MEL 601760 consists of three envelopes of material together with Mueller's rough description of the species. One envelope contains a number of fragments together with capsules and seed of the species, while the other envelopes have a number of dissected flowers displaying the unusual stamen shape. I have no hesitation in choosing the latter sheet as lectotype of the species.

### Distribution

As with *D. glabra*, *D. forrestii* is found in the northwestern region of Western Australia, but it is more widespread being found in areas peripheral to the Hamersley Ranges. Fig. 29.

### Ecology

*D. forrestii* is usually found within rocky water-courses or on the scree slopes of gorges throughout its range. Flowering is variable, perhaps dependent on rainfall, as flowering specimens have been collected from February to September.

### Specimens examined

WESTERN AUSTRALIA: *Ashby 4115*, 3.viii.1971, c. 135 km from Nanutarra which is ca. 105 km SSE of Onslow (AD); *Blockley 21*, 14.ix.1965, 17 miles from Duck Ck Junction nr Mt Farquar in Iron Stone Gorge (KINGS PARK); *Blockley 94*, 28.ix.1965, at Store Hut bore (KINGS PARK); *Blockley 781*, 23.vii.1968, Boolloo Downs Stn, near Cootamudgie Well (KINGS PARK); *Broadbent 1992*, 2.vi.1954, Wittenoom (CANB); *Butler s.n.*, 9.iv.1959, 10 m S of Carnarvon (PERTH); *Chadwick 1346*, 8.ix.1964, 23 km from Learmonth Wapet Camp. On Wapet No. 4 well road, 130 m S Cape Range (PERTH); *Davis 30*, 29-30.v.1979, 22° 30' S, 120° 58' E. (PERTH); *Davis 62*, 31.v.1979, 22° 30' S, 121° 00' E. (PERTH); *Forrest s.n.*, 1882, Menilyalya R, north of Shark Bay (MEL 601760, lectotype; MEL 601759, K); *Gardner 3154*, 24.viii.1932, Hamersley Range (PERTH); *Gardner 3168*, 26.viii.1932, Upper Hardey River, Hamersley Range (PERTH); *Gardner 6129*, 26.ix.1941, Bank of Lyons River (PERTH); *George 1238*, 29.viii.1960, 14 miles E of Bullara (PERTH); *George 3595*, 5.iii.1962, 22 miles E of Wittenoom (PERTH); *Giles s.n.*, s. dat. Upper Ashburton River (MEL 602000 — labelled as type of *J. kempeana* var.); *Goodall 1167*, 12.vi.1964, 15 km W of Learmonth (PERTH); *Hos s.n.*, 9.ii.1976, West Angelas (PERTH); *Hutchinson 116*, 6.v.1971, Gifford Creek Station, Upper Gascoyne (PERTH); *Kenneally 7324*, 28.vii.1980, 30 km S of Exmouth, behind Learmonth Aerodrome in the Cape Range, NW Cape (PERTH, CANB, K, L n.v.); *Robinson s.n.*, 7.ix.1959, South Barlee Range (PERTH); *Royce 1516*, 12.v.1947, Jigalong Base Camp, No. 1 Rabbit Fence (PERTH).

## 19. DICLIPTERA A.L. Juss.

The first description of Australian material of *Dicliptera* was by Nees von Esenbeck (1847a) who described a Cunningham collection from Goalba [Goulbourn] Island as a new genus and species, *Brochosiphon australis*.

This was followed by Mueller's (1867) descriptions of two new species of *Dicliptera*, *D. armata* from the Northern Territory and *D. racemifica* from Cape York Peninsula. A third species was assigned by him (Mueller 1870) to *D. burmanni*, a Javan species which had first been described by Nees.

In Bentham's (1868) 'Flora Australiensis' treatment, Mueller's *D. armata* and *D. racemifica* were renamed as *D. glabra* (which also included *Brochosiphon australis* Nees) and *D. spicata* respectively. Both of these species had first been described by Decaisne from Timor in 1834. The third species, mentioned by Bentham, continued to be referred to by Mueller (1889) as *D. burmanni* Nees, until F.M. Bailey (1901) assigned it to *D. leonotis* Dalz. ex Clarke, an Indian species first described by Clarke in 1885.

**Dicliptera** A.L. Juss., Ann. Mus. Natl. Hist., Nat. 9 (1807) 267 (nom. cons.); Benth., Fl. Austral. 4 (1868) 552; Benth. & Hook. f., Gen. Pl. 2 (1876) 1120; Lindau in Engl. & Prantl, Nat. Pflanzenfam. IV. 3b (1895) 331.

*Type species: D. chinensis* (L.) A.L. Juss. (China).

*Brochosiphon* Nees in A. DC., Prodr. 11 (1847) 492.

*Type species: B. australis* Nees (Australia).

Herbs, linear cystoliths on all parts; branches 6-angled. *Leaves* simple, petiolate, entire. *Inflorescence* a dense or loose, axillary, fan-like aggregation of 1-5 (-8) shortly pedunculate 'bracteate clusters', each subtended by pair of keeled spines, these sometimes combined into terminal spike; *bracteate cluster* consisting of 1-5 shortly pedunculate pairs of unequal, appressed and spine-tipped bracts, each pair enclosing 2 or more bibracteolate flowers, at any one time only one flower developing fully either in a chasmogamous or cleistogamous fashion, the rest rudimentary or ?dormant. *Bracts* free, orbicular to spatulate, enclosing tube of chasmogamous flower and enclosing mature capsules. *Bracteoles* free, tiny, lanceolate, inserted just below calyx and equal to about half its length. *Calyx* segments 5, fused at base, acute. *Chasmogamous flowers*: corolla with thin tube twisted through 180°, widening apically into throat; limb 2-lipped, pink to purple with rare white flowers in population, upper lip shortly 3-lobed, lower lip entire or notched; *stamens* 2, inserted on corolla tube, exserted or rarely included; filaments pubescent in lower half; anther cells 2, linear or more or less globose, usually inserted at unequal levels, rarely (*D. australis*) at equal levels, without appendages; disc thickened, annular with irregular rim and 1-2 appendages on abaxial side; *ovary* pubescent, 1 or 2 ovules per cell; style long, exserted from flower or rarely included, equally 2-lobed at apex. *Cleistogamous flowers*: corolla tiny, tubular for most of its length, tube apparently not twisted through 180°; lobes very short, pubescent, remaining closed about stamens; *stamens* 2, included; anther cells 2, more or less globose, superposed; ovary pubescent, 1 or 2 ovules per cell; style short, not exserted from flower, entire or unequally 2-lobed at apex. *Capsule* arising from both types of flowers indistinguishable except initially by persistent long or short style, compressed, usually more or less round, thickened about circumference, with short apical beak, splitting medially into 2 valves which are projected upwards when thickened rim splits; seed-bearing hooks robust, 1 per valve. *Seeds* usually 2 per capsule, rarely 1, discoid, smooth or tuberculate, tubercles sometimes with barbs (glochidiate). Fig. 31.

### Distribution

*Dicliptera* probably consists of 80-150 species in the tropical and subtropical regions of the world, although Leonard (1958) puts the number as high as 300. In Australia there are six species, four of them endemic and two more widespread in Malaysia. In the South Alligator area of the Northern Territory and the Mitchell/Herbert Rivers area of Queensland introgression may occur between *D. ciliata* and either *D. spicata* or *D. armata* (see Note 3 below and *D. armata*, Note 2).

### Notes

1. *D. australis* from Goulbourn Island has been recognised as distinct from *D. arnhemica* from adjacent Arnhem Land. The former has included stamens and stigma, while the latter has them far exserted. Further investigation of their relationships may prove them to be more allied than the present taxonomy suggests, but more needs to be known of *Dicliptera* species occurring on Goulbourn Island.

2. While tiny cleistogamous flowers predominate in *D. spicata*, *D. ciliata*, *D. armata* and *D. miscella*, these are not evident in *D. australis* and *D. arnhemica* from Goulbourn Island and Arnhem Land, Northern Territory. The cleistogamous flowers are easily recognized by their small size (c. 2-3 mm long). They appear "bud-like" by their corolla lobes which never open, but these are soon pushed out of the bract pairs by the developing fruit. The young capsule is frequently left with a small style, 2-3 mm long, which contrasts with the much longer styles crowning the apex of capsules developing from the chasmogamous flowers. These longer styles were the only ones found in *D. australis* and *D. arnhemica*, while the other four species had both long and short styles present on the capsule apices, but usually with a greater number of the latter within any one bracteate cluster. Thus *Dicliptera* species in the field will often appear not to have flowers, but closer investigation will usually reveal the cleistogamous flowers to be

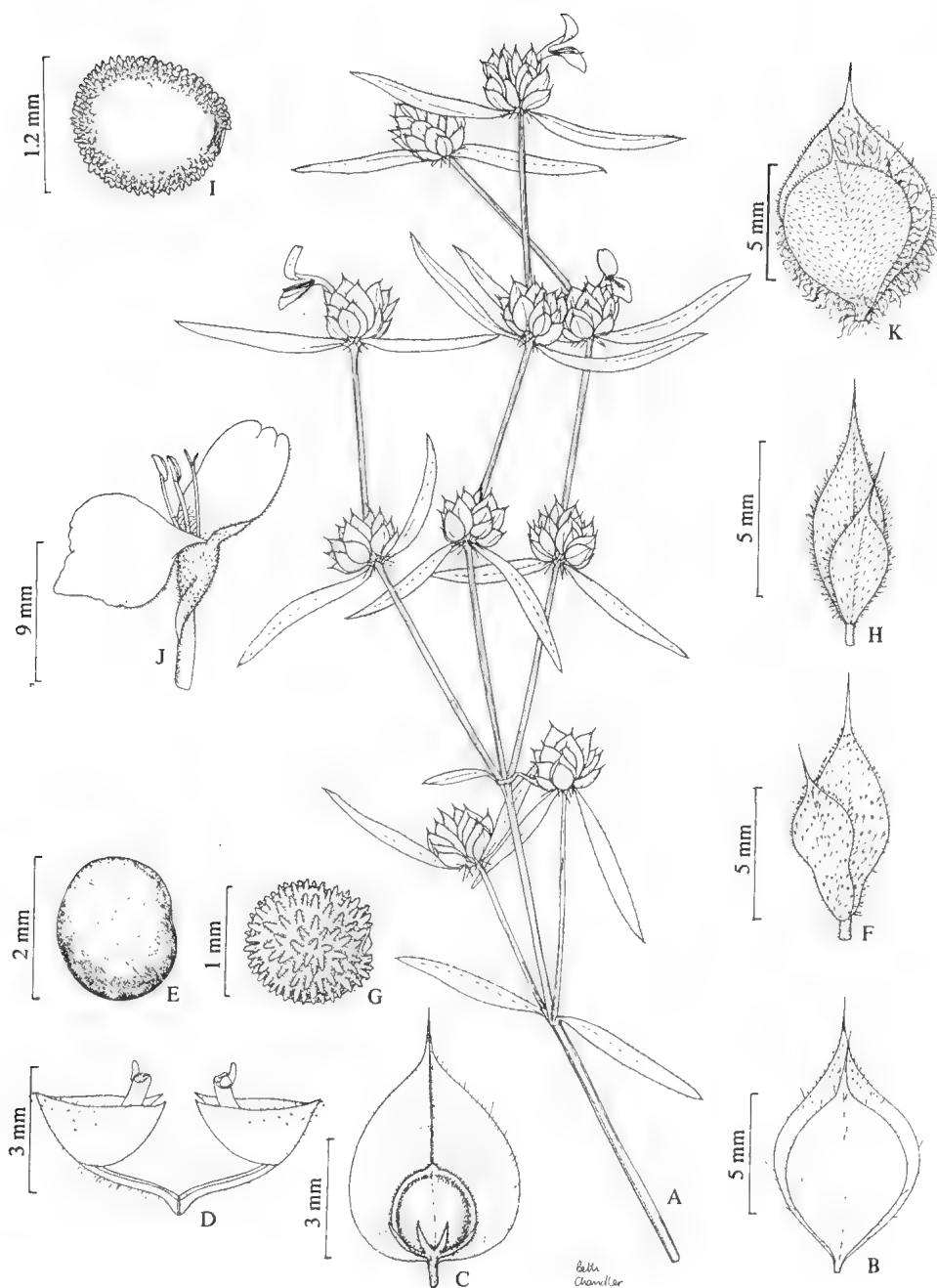


Fig. 31. *Dicliptera*. A-E, *D. armata* F. Muell. A, habit; B, pair of involucre bracts; C, anterior involucre bract removed to show developing fruit and calyx; D, opened capsule with seed-bearing hooks, seed lacking; E, seed (Kenneally 8028). F, G, *D. ciliata* Decne. F, pair of involucre bracts; G, seed (Wilson 11405). H, I, *D. spicata* Decne. H, pair of involucre bracts; I, seed (Pedley 2713). J, K, *D. arnhemica* R.M. Barker. J, flower showing twist through 180° of corolla tube and equally inserted anther cells; K, involucre bract pair (R.M. Barker 415).

present within the bracts along with capsules and seeds. The description of the cleistogamous flowers has been included under the generic description since they appear to be the same between species.

3. *Dicliptera* is in much need of revision throughout its range. Nees (1847a) is the only worker to have looked at the genus world-wide and he recognised five sections based predominantly on bract shape, but this seems to be an artificial arrangement of the species involved. Australian material seems to differ greatly from the American species described by Leonard (1958) and Gibson (1974) in inflorescence arrangements, flower shapes and bract numbers. Despite this there are some apparent morphological links between the American and Australian species. The four endemic Australian species possess smooth seeds as opposed to the more usual glochidiate or tuberculate seeds of Malesia, India and Africa, but Gibson (1974) records some American species as also having this characteristic. Similarly, the equally inserted anther cells of flowers of *D. australis* and *D. arnhemica* seems to be unique amongst Malesian, Indian and African species, but once again there are some species from America (Gibson l.c.) which share this trait.

4. There is a single collection (Lawrie 28) from Murray Island, northeast of the tip of Cape York Peninsula, which seems to represent a close approach to the true *D. glabra* Decne. of Timor. The seeds possess glochidiate tubercles about their circumference, the dense inflorescence clusters overlap at successive nodes and the bract shape is similar to that of type material seen of *D. glabra*. Some minor variation from the type occurs in the presence of a short, erect pubescence on the outer surface of the bract pairs (glabrous in *D. glabra*) and the bracts of the Lawrie collection being attenuate at the base rather than truncate to rounded. Unfortunately type material of *D. glabra* lacks leaves and flowers and an exhaustive comparison cannot be made, particularly as the Lawrie collection is also inadequate for obtaining floral data. Because of this a description has not been made, although the material has been included in the key. Types and the Lawrie collection are cited after *D. armata*.

5. There is a group of specimens, all from the Mitchell or Herbert River regions of north Queensland, together with two from southern coastal New Guinea, differing from *D. ciliata* to some extent in bract size and indumentum and seed sculpturing. The bracts are usually wider than typical *D. ciliata* and approach more the size of those of *D. armata* (Fig. 31b), and to some extent the shape, as they are not so markedly spatulate as those of *D. ciliata*. In addition they lack the very long eglandular hairs seen in *D. ciliata* having instead a covering of shorter (0.5-1 mm long), finer eglandular hairs, more typical of those seen in *D. spicata* (but not as dense and not confined to the margins) and *D. eriantha* Decne., another Timorese species. This last species differs from the specimens in the possession of a long mucro at the apex of the bracts. The specimens also lack the large-topped glandular hairs (though still possessing some glandular hairs) which are usually a conspicuous feature of *D. ciliata* and the glochidiate tubercles of the seed are usually only present about the margin as in *D. spicata*.

The collections resemble *D. ciliata* with respect to the inflorescences and leaf shape and should key out under that species, although information on the characteristics of the chasmogamous flowers is lacking as there seem to be predominantly cleistogamous flowers produced.

Similarly collections from the South Alligator River may sometimes show characteristics of other species while still being closest to *D. ciliata*. Parker 658 shows some approach to *D. spicata* in the presence of slender, moderately dense, eglandular hairs along the length of the bracts although the hairs are nowhere as dense as those found in *D. spicata*. Other characteristics in which it approaches *D. spicata* are the lack of the prominently glandular hairs

which occur in *D. ciliata* and the inflorescences in the apical part not remaining in distinct clusters. *Barker 441* on the other hand, probably collected from the same locality as *Parker 658*, is typical of *D. ciliata* in Australia.

The Mitchell collection from South Alligator River approaches to some extent *D. armata* in its almost glabrous bracts and almost smooth seed. The bract shape remains that of *D. ciliata* as does the inflorescence arrangement.

The presence on the older parts of many of the specimens of *D. spicata* and *D. ciliata*, of a few bracts similar in shape and indumentum to those of *D. armata*, or *D. glabra* Decne, may indicate that all of these species are more closely related than the present classification suggests. Alternatively there may be introgression into *D. ciliata* of characteristics of the various species which are sympatric with it.

### Key to the species of *Dicliptera* in Australia

- 1a. Inflorescences at successive nodes always separate. Seed smooth or glochidiate all over .....2
- 1b. Inflorescences at successive nodes overlapping towards apex of branches, remaining separate lower down. Seed glochidiate about margin .....6
- 2a. Stamens with anther cells inserted at equal levels. Flowers chasmogamous only. Corolla lobes 10-17 mm long, rarely 5.5-8 mm long, upper lip striated. Capsules with glandular hairs only .....3
- 2b. Stamens with anther cells inserted at different levels. Flowers chasmogamous and cleistogamous. Corolla lobes 4-10 mm long, upper lip often blotched but not striated. Capsules always with eglandular hairs, sometimes mixed with glandular hairs .....4
- 3a. Bracts apart from short pubescence, with very slender, long, flexuose eglandular hairs at least at base, sometimes all over. Stamens and stigma exerted from corolla .....5. *D. arnhemica*
- 3b. Bracts shortly pubescent, lacking long hairs. Stamens and stigma included in corolla .....6. *D. australis*
- 4a. Seed tuberculate-glochidiate. Anther cells globular, 0.3-0.5 mm long. Bracts in lower half at least with moderately dense slender eglandular hairs visible with the naked eye and 0.5-2.5 mm long. Corolla lobes 4.8-7 mm long. Leaves lanceolate to ovate .....1. *D. ciliata*
- 4b. Seed smooth. Anther cells linear, 0.7-1.4 mm long. Bracts without long, slender eglandular hairs, with indumentum various (see below). Corolla lobes 8-10 mm long. Leaves linear to lanceolate .....5
- 5a. Bracts orbicular; base truncate or rounded, external indumentum either completely glabrescent apart from sparse 1-4-celled eglandular hairs on margin or a sparse cover of small, erect eglandular hairs, sometimes mixed with short glandular hairs .....3. *D. armata*
- 5b. Bracts spatulate to elliptic; base cuneate, external indumentum a dense mixture of tall, prominently glandular hairs mixed with much shorter glandular or eglandular puberulence .....4. *D. miscella*
- 6a. Bracts ovate, 2.5-4 mm wide, densely bearded with straight eglandular hairs along the whole margin, apical spine 2-3 mm long .....2. *D. spicata*
- 6b. Bracts broadly ovate, the larger of a pair 6-10 mm wide, not bearded along margin, apical spine 0.7-1 mm long .....? *D. glabra* (see Note 4 after the genus).

### 1. *Dicliptera ciliata* Decne., Nouv. Annal. Mus. Hist. Nat., Paris 3 (1834) 384.

*Syntype*: *Guichenot s.n.*, s. dat., Timor (P, MEL, ? BM, ? K).

*D. burmanni* auct. non Nees: Nees in A. DC., Prodr. 11 (1847) 483 p.p. (as to Timorese and probably Javan material); F. Muell., Fragm. Phyt. Austral. 7 (1870) 62; F. Muell., Syst. Census Austral. Pl. (1882) 99; F. Muell., Sec. Syst. Census Austral. Pl. (1889) 168.

*D. leonotis* auct. non Dalz. ex Clarke: F.M. Bailey, Qld Fl. 4 (1901) 1149; F.M. Bailey, Compr. Cat. Qld Pl. (1913) 374; J. Green, Cens. Vasc. Pl. W. Austral. (1981) 95.

Erect herb 37-50 cm high. *Branches* 5-6-angled, downturned eglandular hairs absent or, if present, extending from angles onto petiole, midrib, margins, veins and sometimes upper and



lower leaf surfaces and peduncles. *Leaves* with petiole 0.5-5 cm long, blade lanceolate to ovate, 3-8 x 0.7-4 cm, base long-attenuate, apex cuspidate, 5-8 main veins, midrib divided in two at base; upper surface darker green than lower, both surfaces glabrous or with scattered eglandular hairs similar to those on branches. *Inflorescences* in all upper axils, compact, often subtended by pair of leaves, those at successive nodes not overlapping, in lower parts at least consisting of c. 5 very shortly pedunculate bracteate clusters; *bracteate clusters* with subtending spines 7-11 mm long, these with short upright eglandular hairs, sometimes mixed with longer, slender eglandular hairs similar to those on bracts, clusters in lower parts consisting of 5-6 shortly-pedunculate bract pairs, in younger clusters or those towards apex only with 1-2 bract pairs, peduncles of these with short upright eglandular hairs mixed with occasional glandular hairs; *bracts* spatulate to obovate, 2.5-6 mm wide, base cuneate, cuspidate at apex, with 3-4 mm long spine or mucro, smaller of each pair 4-6 mm long, larger 8-10 mm long, externally in lower half with 1.5-2.5 mm long, multicellular, slender, erect, eglandular hairs particularly on margin, sometimes extending onto midrib of inner surface, mixed with shorter, 0.1-0.2 mm long, eglandular hairs which also extend onto upper half of external surface, mixed with slightly longer glandular hairs with prominent apical gland, 0.08-0.1 mm diameter, shorter eglandular and glandular hairs usually present on both inner and outer surface of bract; *flowers* often predominantly cleistogamous and inconspicuous. *Bracteoles* with glandular hairs similar to those on bracts, mixed with shorter eglandular hairs. *Calyx* of similar length and indumentum to bracteoles. *Corolla* deep pink or purple, without striations, upper lip with darker markings at base, externally with sparse indumentum of eglandular hairs mixed with occasional glandular hairs, internally filaments decurrent with tube as two pubescent ridges; in chasmogamous flowers tube 3-3.5 mm long, throat 1.5-2.5 mm long, lobes 4.5-7 mm long. *Stamens* of chasmogamous flowers with filaments and anthers yellow; anther cells inserted at distinctly unequal levels, superposed, more or less globose, c. 0.3-0.5 mm long. *Ovary*: style yellow, 8-10 mm long. *Capsule* with eglandular hairs over external surfaces, 2-seeded. *Seed* 1.5-1.7 mm diameter, glochidiate. Fig. 31 F-G.

### Typification

The Guichenot material in P is the only type material seen of this species. Decaisne (1834) did not list specimens, but it is known that his work was based on the collections held 'Herb. Timorensis' in P, thus making this type material. According to van Steenis-Kruseman (1950), Guichenot's collections are represented by duplicates in the Delessert herbarium housed in G and possibly in BM and K, and so it is possible that there are syntypes in these institutions. Until this is ascertained the type status of the Guichenot collection cannot be resolved. The P material is in excellent condition and consists of one whole plant with three other branches; flowers, capsules and seeds are present.

There is a specimen in MEL which has a label bearing the determination *Dicliptera ciliata* in exactly the same hand as that of the type, but it has been mounted with a clearly misplaced *Lindernia* (Scrophulariaceae) specimen. This means there may be syntype material in MEL, but whether it can now be located is unknown at this stage.

### Distribution

In Australia *D. ciliata* has been recorded from the Mitchell Plateau and Prince Regent River areas of Western Australia, from Humpty Doo and South Alligator River in the Northern Territory and from a number of islands and coastal rivers of the Cape York Peninsula area of Queensland (Fig. 32). Outside Australia it is found on Timor and probably extends to Java as well as the Philippines (see Note 1).

### Ecology

Very little is known although Western Australian collections have come from 'vine thicket'

associated with laterite or basaltic loam, while collections from Northern Territory were found as an understory in monsoon woodland. Flowering is from April to August.

### Note

#### 1. Choice of name for the species

The name of the Australian material, which has been assigned to *D. burmanni* and *D. aff. leonotis* in the past, is still open to question. The reasons for selecting the name *D. ciliata* Decne. are outlined here, together with a history of the two earlier names, *D. chinensis* and *D. burmanni*, which might conceivably have applied to the species (see Table 16). These appear to be the only names which need to be considered from the Malesian area, but when more is known about Indian and Chinese *Dicliptera* species, other epithets may also need to be investigated. Since Clarke (1900) lists *D. leonotis* as occurring in tropical Africa, African relationships should also be considered.

*Justicia chinensis* was first recognized by Linnaeus in 1753 from China and was described as having oval bracts with an obtuse apex. Subsequently there was much confusion in application of this name culminating with Nees von Esenbeck's (1832) statement that *J. chinensis* of previous authors included at least three species, perhaps one from a "foreign [to Asia?]" place to which the words in Linnaeus's original description "bracteis ovatis obtusis" applied. He later (Nees 1847a) compounded the problem by describing his own *D. chinensis* based on Vahl's concept of *J. chinensis*, in which the bracts were described as oval with a mucronate or cuspidate apex.

In the earlier treatment (1832) Nees had described *D. burmanni* which was based on a single specimen Wight 2016 (Wallich Cat. 2466c) from India, N.L. Burman's (1768) description and illustration of *J. chinensis*, Lamarck's (1791) treatment of *J. chinensis*, and questionably Linnaeus's (1753) *J. chinensis*.

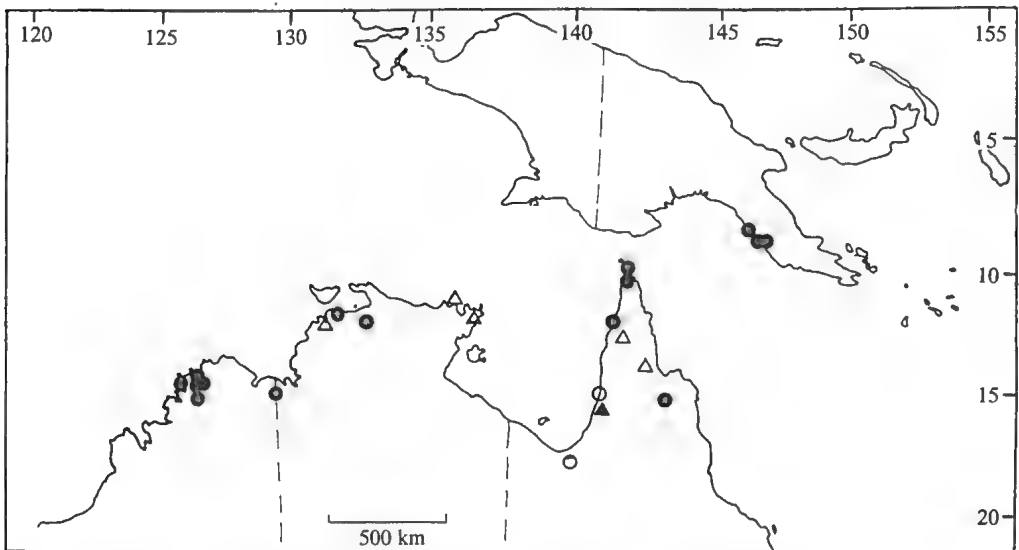


Fig. 32. Distribution of *Dicliptera ciliata* ●, *D. aff. ciliata* ○, *D. spicata* △, *D. aff. spicata* ▲.

Name	Date described	Bract shape	Bract apex	Habitat
<i>J. chinensis</i> L.	1753	oval/ovate	obtuse	China
<i>J. chinensis</i> sensu Burm. f.	1768	oval	acuminate	China (?cultivated in Java)
<i>J. chinensis</i> sensu Vahl	1791	ovate	mucronate	? China
<i>D. burmanni</i> Nees	1832	spathulate (ciliate)	mucronate/ cuspidate	India (Wight specimen), Java (Burm.f. illustration), China (Lamarck reference)
<i>D. ciliata</i> Decne.	1834	spathulate (ciliate)	mucronate/ cuspidate	Timor
<i>D. chinensis</i> sensu Nees	1847	oval (ciliate)	mucronate/ cuspidate	China, India Java
<i>D. leonotis</i> Dalz. ex Clarke	1885	oblong lanceolate	acuminate cuspidate	India

Table 16: History of epithets used previously for *D. ciliata*.

Burman's illustration was of a Javan collection made by Garcin (possibly housed in Burman's herbarium at G) of a "planta, quae in urbe Batavia crescit juxta muros", but the habitat was given as China. It is not impossible that the Javan collection was an introduction from China as Burman's illustration and description of the bracts as oval with an acuminate apex matches the limited Chinese material I have seen. This includes syntype material of *J. chinensis* L. in which the bract apex seems to vary from obtuse to shortly acuminate, and the illustration and description by Hsieh & Huang (1978) in 'Flora of Taiwan'. It is unlikely to be a native to Java as *Dicliptera* species there (Backer 1965) all have a long thin mucro at the apex of the bract.

Clarke (1885) rejected *D. burmanni* as the name of the species in India represented by the Wight collection, claiming that as Nees had based his name on Burman's figure of a Javan species and the material of Wight did not match this, a new name was required. His new name for the Indian species was *D. leonotis*. However, it can be argued that as Nees saw only a single specimen (Wight 2016 from India) then this automatically becomes the holotype of *D. burmanni*, thus rendering *D. leonotis* superfluous.

If it is accepted that *D. burmanni* applies to Indian material, what then happens to Javan material? The earliest name applying in this area is that given by Decaisne (1834) to a Timorese species, *D. ciliata*. This species was mentioned in the synonymy of *D. burmanni* by Nees in his later (Nees 1847a) treatment of *Dicliptera*, and it needs to be established whether or not the two are synonymous. I have seen material of *D. ciliata* (its type) and apparently *D. burmanni* (in the form of the type of *D. leonotis*) and the two differ; *D. ciliata* possesses spathulate bracts with moderately dense, eglandular hairs up to 2-3 mm long on the widest portion of the bract, densely eglandular hairy capsules and glochidiate seeds, while *D. burmanni* (or *D. leonotis*) has more or less elliptic bracts mostly lacking such long hairs, densely glandular hairy capsules and very shortly tuberculate, but not glochidiate, seeds. Whether or not these distinctions always apply and, even if they do, whether they are worthy of specific status can only be determined by a revision of the species involved over their entire range. Until then the Australian material, being conspecific with the Timorese *D. ciliata* Decne, must be assigned this name.

2. For a discussion of specimens which show affinities to *D. ciliata* see Note 4 after the genus.

*Specimens examined**Dicliptera ciliata*

NORTHERN TERRITORY: *R.M. Barker 412*, 4.v.1983, Harrison Dam (AD); *R.M. Barker 441*, 6.v.1983, c. 2 km W of S Alligator River, almost opposite S. Alligator Inn on Arnhem Hwy (AD); *Muspratt 550623*, 13.v.1963, 200 yards S Harrison Dam, Humpty Doo (DNA).

QUEENSLAND: *Bailey s.n.*, vi.1897, without locality (BRI 137302); *Bäurlen 71*, 7.viii.1885, Thursday Island (MEL 100740); *Harris s.n.*, 1880, Possession Island (MEL 100738); *Hind 334*, 22.viii.1973, Cabbage Tree Creek, 1.6 km S of Kennedy R. Crossing (NSW); *Missionary s.n.*, 1894, Batavia River (MEL 100729).

WESTERN AUSTRALIA: *George 12284*, 14.viii.1974, Bushfire Hill, Prince Regent River Reserve (CANB, PERTH); *Kenneally 5154*, 19.vi.1976, 9 km SW of Amax Base Camp, Mitchell Plateau (PERTH); *Kenneally 6653*, 17.x.1978, Mitchell Plateau (PERTH); *Perry 2648*, 29.vii.1949, Point Springs, 29 m E of Carlton Stn (NT, NSW, CANB, MEL); *Wilson 11405*, 6.vii.1973, N side Prince Frederick Harbour (PERTH).

*Dicliptera aff. ciliata*

NORTHERN TERRITORY: *Mitchell s.n.*, 31.iii.1976, South Alligator 12° 45', 132° 32' (NT); *Parker 658*, 18.iv.1975, 2 km W of S. Alligator River, Arnhem Hwy (DNA).

QUEENSLAND: *Anon s.n.*, 4.ix.1867, Herbert River (MEL 100707); *Anon. (?Palmer) 52*, s. dat., Mitchell River (BRI); *Palmer 752*, s. dat., Mitchell scrubs (NSW); *Palmer 18a*, 29.ix.1882, Mitchell River scrubs (MEL); *Palmer s.n.*, 1882, Flinders River (MEL 100736).

NEW GUINEA: *Darbyshire 834*, 20.viii.1962, C. 2 m N of Ikikina village, Kairuki Subdistrict, Central District, Papua (LAE); *Heyligers 1202*, 13.v.1965, Tovobada Hills, 12 m N of Port Moresby (LAE); *Pajmans 1842*, 16.v.1975, Galley Reach mangroves, 50 km NW of Port Moresby (LAE).

## Non-Australian species examined

1. *Dicliptera ciliata* Decne.

TIMOR: *Guichenot s.n.*, s. dat. (P: syntype of *D. ciliata* Decne.).

2. *D. leonotis* Dalz. ex Clarke (? = *D. burmanni* Nees).

INDIA: *Dalzell s.n.*, ix.1874, Ajnera hill, near Nassick (K: 2 sheets: syntypes).

3. *D. chinensis* L.

CHINA: *Anon. s.n.*, s. dat. (LINN 28: 19); *Tanaka & Shimada 13, 464*, l.xii.1932, Tomita-cho, Taihoku-shi (MEL).

JAPAN: *Yamazaki 1694*, 13.ix.1977, Ryukyu Is.: Kumezima, Gushikawason, Katekari (AD).

2. *Dicliptera spicata* Decne., Nouv. Annal. Mus. Hist. Nat., Paris 3 (1834) 384; Nees in A. DC., Prodr. 11 (1847) 479; Benth., Fl. Austral. 4 (1868) 553; F. Muell., Syst. Census Austral. Pl. (1882) 99; F. Muell., Sec. Syst. Census Austral. Pl. (1889) 168; F.M. Bailey, Qld Fl. 4 (1901) 1149; F.M. Bailey, Compr. Cat. Qld Pl. (1913) 374 (but probably not as to f. 350); Ewart & Davies, Fl. N. Terr. (1917) 252.

*Lectotype here designated: Riedlè s.n.*, s. dat. (1801), Isle de Timor (P); *syntypes (possible isoelectotypes): Anon s.n.*, s. dat. Timor (G — DC: microfiche AD; MEL).

*D. racemifica* F. Muell., Fragm. Phyt. Austral. 6 (1867) 89.

*Lectotype here designated: Daemel s.n.*, s. dat., Cape York (MEL 601930); *isoelectotypes: (MEL 6001928, MEL 601929, K).*

Erect herb 17-45 (-75) cm high. *Branches* 5-6 angled, glabrous or with tiny downturned eglandular hairs on angles and nodes, these extending onto petiole, base of midrib, basal parts of younger leaves, base of axillary spines, peduncles and base of spine pairs subtending bracteate clusters. *Leaves* with petiole to 2 cm long on larger leaves, blade more or less elliptic,

2.2-6 x 0.4-2.3 cm, base attenuate, apex cuspidate, 3-5 main lateral veins, midrib divided in two at base; upper surface much darker than lower, both surfaces more or less glabrous, sometimes with occasional stout 3-4-celled eglandular hairs, only rarely (*Pedley 2713*) basal margins with few long ciliate hairs similar to those on bracts. *Inflorescences* in upper axils together forming a continuous false spike, usually without leaves, those at successive lower nodes not overlapping, usually subtended by pair of leaves, these sometimes lacking, consisting of 1-3 (-6) loosely arranged pedunculate bracteate clusters, peduncle to 2-3 mm long; *bracteate clusters* subtended by spines 4-6 mm long, each cluster composed of 1 or 3 bract pairs, in some cases only paired spines present and bract pairs lacking, peduncles 0.1-2 mm long, eglandular hairy; *bracts* ovate, 2.5-4 mm wide, smaller c. 5 mm long, larger 6.5-8 mm long, attenuate to cuneate at base, cuspidate, spine 2-3 mm long at apex, externally with very dense, straight, 0.4-0.7 mm long, slender eglandular hairs, mostly confined to whole length of margin and sometimes midrib, internally with shorter glandular hairs in which apical gland is small (of similar diameter to width of hair) or large, sometimes at lowest inflorescence bearing axil, bracts orbicular and glabrous as in *D. armata*; *flowers* a mixture of chasmogamous and cleistogamous. *Bracteoles* with very short eglandular hairs mixed with occasional longer eglandular hairs. *Calyx* slightly exceeding bracteoles and of similar indumentum. *Corolla* purplish-pink to lavender, ?without darker striations or spots, on outer surface with sparse eglandular indumentum mixed with occasional shorter glandular hairs, inside tube with a pubescent ridge decurrent from each filament; in chasmogamous flowers tube 2-3 mm long, throat 0.5 mm long, lobes 3.5-4 mm long. *Stamens* of chasmogamous flowers with filaments and anthers ?yellow, anther cells inserted at distinctly unequal levels, superposed, more or less globose, c. 0.3-0.6 mm long. *Ovary*: style yellow, c. 6-7 mm long. *Capsule* with moderately dense, long, 3-4-celled eglandular hairs on pedicel and apex, sometimes mixed with few short glandular hairs, indumentum sparser or absent on rest of capsule. *Seed* 1 mm diameter, discoid with glochidiate tubercles, 0.1 mm long, about margin only. Fig. 31 H, I.

### Typification

#### 1. *D. spicata* Decne.

The Riedlé collection of *D. spicata* from Timor in P has been chosen as lectotype of the species being the only fully annotated specimen and in the Timor collection upon which Decaisne worked. It has no chasmogamous flowers present but there are a number of buds and many mature capsules, some with seed. The collection of the species in G-DC (seen on microfiche in AD) originates from P where Decaisne worked, but has no indication of the collector.

The MEL collection also has no indication of collector. There may be other syn- or isolectotypes in BM or K, as Riedle's collections may be represented there (van Steenis-Kruseman 1950).

#### 2. *D. racemifica* F. Muell.

Of the four Daemel collections seen, only MEL 601930 bears a detailed description of *D. racemifica* in Mueller's handwriting; this sheet has been designated as lectotype.

### Distribution

In Australia *D. spicata* collections come from Cape York Peninsula, Queensland and Arnhem Land in the Northern Territory (Fig. 32). It also occurs in Timor, but this seems to be the extent of its occurrence in Malesia. It has not been recorded from New Guinea and there are no specimens in material I have seen from LAE.

### Ecology

*D. spicata* seems to have mainly been found along creek banks associated with monsoon or rainforest. Flowering specimens have been collected most commonly from June to August.

### Note

The differences between *D. spicata* and *D. ciliata* sometimes appear to break down. There is one group of specimens from northern Queensland and southern Papua and another from the South Alligator River of Northern Territory area, which appear to be more allied to *D. ciliata* in some of their characteristics (see under *D. ciliata* list of specimens and Note 4 under genus for discussion).

### Specimens examined

NORTHERN TERRITORY: *Holtze* 399, 1884, Port Darwin (MEL 100730); *Holtze* 808, 1888, Port Darwin (MEL); *Maconochie* 2241, 2.vii.1975, Elcho Island (NT); *Must* 1042, 21.vi.1972, 31 m S of Giddy River Crossing (CANB, DNA, K, NT); *Tenison-Woods & Holtze* 399, 1886, North Australia (MEL).

QUEENSLAND: *Brass* 19833, 13.viii.1948, Bonanza Creek, Upper Peach River, Cape York (BRI, CANB, K); *Clarkson* 3610, 7.xi.1980, 18 km NW of Silver Plains Station, Massey Creek (QRS, K); *Daemel* s.n., s. dat., Cape York (K, MEL 601928, MEL 601929, MEL 601930); *Pedley* 2713, 26.vi.1968, Arthur Creek, c. 40 miles E of Weipa (CANB); *Ramsey* s.n., s. dat., Cape York (NSW 151869); *Skerman* s.n., viii.1955, Cape York Peninsula (BRIU S-4).

TIMOR: *Riedle* s.n., s. dat. Isle de Timor (P: lectotype); *Anon* (*Riedle*) s.n., s. dat. Timor (G-DC, MEL: syntypes).

### *Dicliptera* aff. *spicata*

QUEENSLAND: *Whitehouse* s.n., s. dat. Mitchell River Mission (BRI 137305).

### 3. *Dicliptera armata* F. Muell., *Fragm. Phyt. Austral.* 6 (1867) 88.

*Lectotype* here designated: *Mueller* s.n., iii.1856, Depot Creek (K p.p.); *probable isoelectotype* (MEL 10074); *syntypes*: *Martin* 46, s. dat. Near Mt Lookover, Glenelg District (MEL 601927); *Mueller* s.n., s. dat. Arnhem's Land (MEL 100710, K p.p.).

*D. glabra* auct. non Decne: Benth., *Fl. Austral.* 4 (1868) 552; F. Muell., *Syst. Census Austral. Pl.* (1882) 99; F. Muell., *Sec. Syst. Census Austral. Pl.* (1889) 168; F.M. Bailey, *Qld Fl.* 4 (1901) 1149; F.M. Bailey, *Compr. Cat. Qld Pl.* (1913) 374; Ewart & Davies, *Fl. N. Terr.* (1917) 252; Gardner, *Enum. Pl. Austral.* (1931) 119; J.S. Beard, *W. Austral. Pl.* 2nd edn (1970) 119; J. Green, *Census Vasc. Fl. W. Austral.* (1981) 95.

*Brochosiphon australis* auct. non Nees: Benth., *Fl. Austral.* 4 (1868) 552, pro. syn.

Erect, sometimes decumbent, annual herb 20-60 cm high. *Branches* 5-6-angled, glabrous or with more or less downturned eglandular hairs on angles of branches and, more densely, at nodes, extending onto petiole, leaf margin, midrib and sparsely onto main lateral veins. *Leaves* with petiole 0-4 (-7) mm long; blade linear to narrowly ovate, 2.8-7 x 0.2-1.8 cm, slightly asymmetrical at base, entire, acute to cuspidate at apex; upper surface glabrous, lower surface more or less glabrous, sometimes with scattered, stout, 3-5-celled eglandular hairs. *Inflorescences* in all upper axils, compact, clusters often subtended by pair of leaves, those at successive nodes not overlapping, composed of 3-5 (-8) shortly pedunculate bracteate clusters, number of bracteate clusters lower in basal and terminal clusters; spines subtending bracteate clusters 6-10 mm long, glabrous or with 2-3-celled eglandular hairs on margin; *bracteate clusters* consisting of 1-3 (-5) shortly pedunculate bract pairs, peduncles glabrous or with a few sparse eglandular hairs; *bracts* more or less orbicular, 6-12 mm wide, rounded or truncate at base, completely glabrous except for stout 1-4-celled eglandular hairs on margins, sometimes mixed with sparse cover of short upright eglandular hairs on both surfaces, sometimes also with short glandular hairs, particularly on inner exposed portion of larger bract, smaller bract of

each pair 4-8 mm long, mucronate at apex, larger bract 7-11 mm long, cuspidate with longer spine to 1.5-2 (-3) mm long; *flowers* frequently predominantly cleistogamous and inconspicuous. *Bracteoles* with short pubescence, sometimes ciliate, sometimes with sparse glandular hairs. *Calyx* longer than bracteoles, with similar indumentum. *Corolla* tube white, lobes pink to purple, upper lip with darker splotches, rarely corolla totally white, externally with sparse eglandular hairs mixed with more scattered, shorter, glandular hairs, internally with sparsely pubescent ribs decurrent from filaments; in chasmogamous flowers tube 6 mm long, throat 1 mm long, lobes 8.5-10 mm long. *Stamens* of chasmogamous flowers with filaments pale pink to white, anther cells deep pink-purple, inserted at distinctly unequal levels, superposed, linear, 0.9-1.4 mm long. *Ovary*: style purple to pink, in chasmogamous flowers 10-16 mm long. *Capsule* covered by eglandular hairs mixed with few shorter glandular hairs, 1-2-seeded. *Seed* 1.9-2 mm diameter, smooth, brown or black, sometimes mottled. Fig. 31 A-E.

### Typification

There is some problem in identifying type material because the localities cited in the original description for Mueller's collections do not agree with those on specimens. In his original description of *D. armata* Mueller (1867) cited his own specimens from Stirling Creek and origins of the Victoria River, with Dr Martin's collection from the 'Glenelg River'. Material seen from MEL includes Dr Martin's collection from near Mt Lookover, Glenelg District, in the Prince Regent River area of north-west Western Australia and two collections made by Mueller in the Northern Territory. One of Mueller's collections, MEL 100714, has the locality "Depot Creek" along with, on a separate label, "Victoria and Camfield River", the other, MEL 100710, has "Arnhem's Land". Both bear the name *D. glabra* Decne. in Mueller's handwriting, as does the specimen *Martin 46*.

In K there is a sheet bearing two Mueller specimens, one from Depot Creek and another from Arnhem's Land. Both labels bear the annotation *D. armata* in Mueller's hand, but the far right hand side specimen, by comparison with Mueller's Arnhem Land collection in MEL, would seem to be the only one related to that label. The rest of the sheet relates to Depot Creek as the collecting locality. None of the specimens seen mention Stirling Creek which is cited in the original description, nor are Camfield Creek, Depot Creek and Arnhem's Land, which appear on specimens, cited in the protologue.

It would have seemed best, therefore, to choose the Martin specimen in MEL as lectotype, it being the only one with a locality agreeing with the protologue, but it lacks flowers and mature capsules with seed. The K material from Depot Creek, however, is labelled as *D. armata* by Mueller and has flowers and capsules present. For these reasons it has been chosen as lectotype. The MEL material, MEL 100714, is probably an isolectotype although the bracts are far more glandular hairy than the other collections.

The collections by Mueller from Arnhem Land, even though not cited in the protologue must be regarded as syntypes since the K material from this locality is annotated as *D. armata* by Mueller; the collections could only have been made on the same expedition as the lectotype collections and the description was published some ten years after the expedition.

### Distribution

*D. armata* is an endemic Australian species common throughout northern tropical Australia (Fig. 33).

### Ecology

This is a woodland understory species usually found at the edges of creeks and rivers, where it is often extremely abundant. Flowering occurs between March and July, with occasional records outside this period.

## Notes

1. Although the bracts vary considerably from being completely glabrous to bearing a rather dense mixture of glandular and eglandular hairs, it has been impossible to divide *D. armata* at the subspecific level. The nature of the indumentum does not appear to correlate with distributional or ecological factors. *D. armata* has therefore been treated as one somewhat variable species, always distinguishable by its smooth seeds and more or less orbicular bracts with truncate bases.

2. *D. glabra* Decne. to which the Australian specimens have always been referred in the past, differs from *D. armata* in the seeds being glochidiate about the circumference, the paler radiating areas on the bases of the bracts, the lack of any indumentum on the bracts (rarely there is a very short glandular pubescence on some of the younger bracts), the overlapping of the dense inflorescence clusters at successive nodes and possibly leaf shape.

## Specimens examined

*D. armata* F. Muell. (representative specimens, 112 seen)

NORTHERN TERRITORY: *R.M. Barker* 319, 27.iv.1983, King River (Tony Green Crossing), Victoria Highway, 30 km SW of Katherine (AD); *R.M. Barker* 324, 28.iv.1983, Stuart Highway, 36.5 km NW of Katherine (AD); *R.M. Barker* 503, 9.v.1983, UDP Falls, 108 km NE of Pine Creek (AD); *R.M. Barker* 513, 9.v.1983, Christmas Creek, 109 km NE of Pine Creek, off road to UDP Falls (AD); *R.M. Barker* 527, 11.v.1983, Stuart Highway, 58.8 km SE of Katherine (AD); *Blake* 17519, 29.iv.1947, about E of Mataranka, on Elsey Station (BRI, CANB, MEL); *Byrnes* 1575, 4.v.1969, Jasper Gorge (AD, DNA, NT); *Craven* 3988, 30.v.1976, McArthur River area (CANB); *Forrest s.n.*, 1879, Port Darwin (MEL 100718, 100720); *Gittins* 2623, vii.1973, above UDP Falls (BRI, NSW, NT); *Latz* 8627, 3.iv.1981, SW Tanami Desert (CBG, NT); *Lazarides & Adams* 9, 3.iii.1965, c. 25 miles NNE of Maranboy Police Station (BRI, CANB, K, NT); *Mueller s.n.*, s. dat. Arnhem Land (MEL 100710); *Nelson* 260, 11.iv.1962, Beswick Station (BRI, CANB, DNA, MEL, NT); *Nelson* 286, 13.iv.1962, 17 m E of Pine Creek (AD, BRI, CANB, NT, PERTH); *Perry* 2101, 9.vi.1949, 16 miles WSW of Victoria R. Downs Station (CANB — 2 sheets, NSW, MEL, NT); *Pullen* 9381, 24.v.1974, Lindsay Creek, on road from 'Mainoru' to 'Bulman' Station, c. 32 km from Mainoru (CANB).

QUEENSLAND: *Brass* 449, iii.1925, Gilbert River (BRI, CANB); *Daintree s.n.*, 1869, Cane Creek, Gilbert River (MEL 100713); *Schmid* AS82, 22.iii.1977, 107 km S of Normanton on Cloncurry-Normanton Road,, Bang Bang Jump-up, (BRI, CANB — 3 sheets).

WESTERN AUSTRALIA: *R.M. Barker* 257, 23.iv.1983, Hidden Valley, 2.5 km E of Kununurra (AD); *R.M. Barker* 286, 25.iv.1983, c. 20 km along King River Road, which is 6.7 km E of Wyndham on Great Northern Highway (AD); *Basedow* 114, v.1916, Sunday Island, between King Island and Exmouth Gulf (NSW); *Blockley* 429, 20.ix.1966, Mt Nicholson-Fortescue River (KINGS PARK); *Gardner s.n.*, viii.1932, Millstream, Fortescue River (PERTH); *George* 12349, 15.viii.1974, Gandjal Creek, Prince Regent River Reserve (PERTH); *Hartley* 14335,

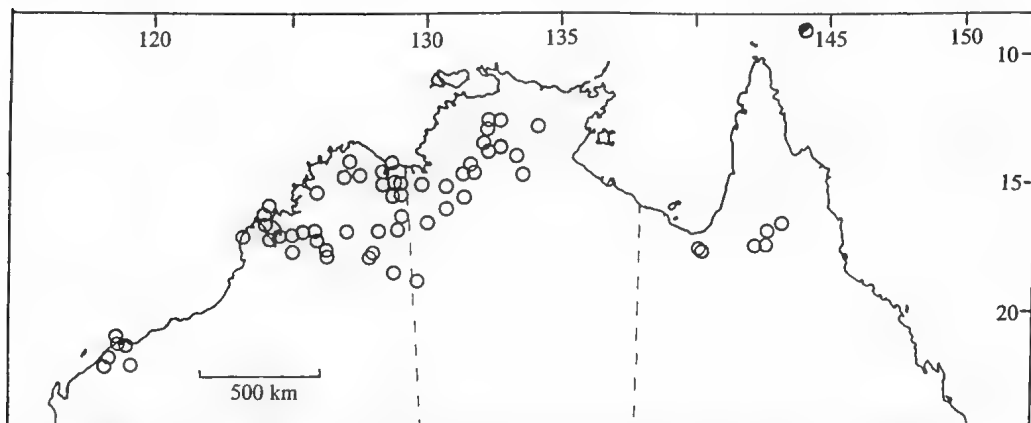


Fig. 33. Distribution of ○ *Dicliptera armata* in Australia and ● *D. aff. glabra* (Murray Island).



7.iii.1978, headwaters of Packsaddle Creek, Northern Carr Boyd Range (CANB, NT, PERTH); *Kenneally* 5912, 17.iv.1977, Deep River, 5 km N of Point Coulomb, Dampier Land, N of Broome, (CANB); *Kenneally* 8270, 11.vi.1982, Sunday Island, Buccaneer Archipelago (PERTH); *Lazarides* 5071, 16.iv.1955, 29 m NW of Springvale Station (BRI, CANB, NSW, NT, PERTH); *Lazarides* 8567, 14.iii.1978, Adolphus Island, 36 km N of Wyndham (BRI, CANB, K); *Maconochie* 1139, 21.v.1971, 35 m W of Halls Creek (NT); *Royce* 6388, 29.v.1960, Dolphin Island, Dampier Archipelago (PERTH); *Wilson* 11465, 8.vii.1973, St Andrew Island, St George Basin (PERTH).

TIMOR: *Riedlè* (?72), s. dat. (P, syntype); *Anon s.n.*, s. dat. (G-DC: microfiche AD; syntype).

#### *D. aff. glabra* Decne.

QUEENSLAND: *Lawrie* 28, vii.1970, Murray Island (BRI).

### 4. *Dicliptera miscella* R.M. Barker, sp. nov.

Species nova, differt a speciebus Malesianibus et Australiensibus omnibus praeter *D. australem* et *D. armatam* seminibus testa laevi, a *D. armata* bracteis spathulatis vel ellipticis et paginis externis bractearum pilis glanduliferis et eglandulosis, et a *D. australi* et *D. arnhemica* loculibus antheris quisque superpositis.

*Holotype*: *Kenneally* 8993, 11.vi.1984, Careening Bay (PERTH); *isotypes*: 3 duplicates to be distributed.

Straggly, often leafless, subshrub to 30 cm high. *Branches* 5-6-angled, glabrous. *Leaves* subsessile, blade narrow linear, 2-5 x 0.3-0.5 cm, base cuneate, apex pungent, sparsely strigose on both surfaces, upper surface darker than lower. *Inflorescences* in all upper axils, compact clusters, sometimes subtended by pair of leaves, those at successive nodes not overlapping, consisting of c. 7 shortly pedunculate bracteate clusters; spines subtending bracteate clusters 8-10 mm long, short upright eglandular hairs on external surface; *bracteate clusters* consisting of c. 3-5 pedunculate bract pairs, fewer in lower axils, peduncles c. 2.5 mm long, very shortly glandular pubescent; *bracts* spathulate to obovate, 2.5-4.5 mm wide, cuneate at base, beaked or acuminate at apex, spine 0.5-2 mm long, externally with a mixture of long, distinctly glandular hairs and shorter glandular or eglandular pubescence, smaller of each pair 3-7 mm long, larger 5-9 mm long, flowers both chasmogamous and cleistogamous. *Bracteoles* with short glandular pubescence. *Calyx* slightly longer than bracteoles, with similar pubescence. *Corolla* deep pink or purple with white spotting in throat, externally with mixture of glandular and eglandular hairs, internally with 2 hairy ridges in tube decurrent from filaments; chasmogamous flowers with tube 4-6 mm long, throat 1-2.5 mm long, lobes (5.5-) 8-9 mm long. *Stamens* of chasmogamous flowers with filaments pink; anther cells linear, 0.7-1 mm long, yellow or ? pale mauve, inserted at distinctly unequal levels, superposed. *Ovary*: style c. 14-16 mm long, pink. *Capsule* with mixture of eglandular and glandular hairs, usually 2-seeded. *Seeds* 1.6-2 mm diameter, smooth, brown.

#### *Distribution*

*D. miscella* is known only by four collections from Careening Bay and Augustus Island, which are both coastal localities in the Bonaparte Archipelago of north-west Western Australia. Fig. 34.

#### *Ecology*

The Careening Bay collections come from a slope behind the beach and from a sandstone gully, while at Augustus Island the plant is recorded as rare within *Eucalyptus* woodland. Chasmogamous flowers are present on all of the specimens; the flowering time is presumably April to June.

## Notes

1. As indicated by the specific epithet this species occupies a position somewhat intermediate between two species, *D. armata* and *D. ciliata*. It possesses the smooth seeds, flower size, anther cell shape and leaf shape of the former while having the bract shape and indumentum (without the long, slender eglandular hairs) of the latter. This raises the possibility of it being a hybrid between the two species since both occur in the area. Only further studies can clarify this.

More information on the extent of its distribution within the Bonaparte Archipelago would be extremely useful, but is unlikely to be forthcoming for some time because of the inaccessibility of the region. It is possible that Alan Cunningham collected this species in his stay at Careening Bay between 20th September and 8th October, 1820 even though he was restricted to shoreline collecting (McMinn 1970) and the species was presumably past its flowering time. Such a collection does not exist in Australian herbaria, but could possibly be found in Kew.

2. *D. miscella* possesses cleistogamous flowers which are somewhat longer (0.6 mm long) than those in other *Dicliptera* species, as well as the usual chasmogamous flowers with corolla lobes c. 8-9 mm long. Some of the specimens, however, also have flowers which are intermediate in size with the corolla lobes 5.5 mm long. Whether there exist three flower sizes on the one plant or the smaller chasmogamous flower is part of the normal range of chasmogamous flower sizes cannot be determined from the few specimens seen.

*Specimens examined*

WESTERN AUSTRALIA: NORTH WEST KIMBERLEY: *Kenneally* 8993, 11.vi.1984, Careening Bay (PERTH); *P.G. Wilson s.n.*, 15.v.1972, Augustus Island (PERTH); *P.G. Wilson s.n.*, 25.v.1972, Careening Bay, S of Coronation Island (PERTH); *P.G. Wilson* 10991, 26.vi.1973, Careening Bay (PERTH).

5. *Dicliptera arnhemica* R.M. Barker, sp. nov.

Species nova, a speciebus omnibus praeter *D. australem* differt loculis antherarum insertis aequalis, corollis striatis et capsulis tantum pilos glanduliferos gerentibus, et a *D. australi* bracteis ad basim pilis longis flexuosis multicellulosis et in pagina externa pilos conspicuos glanduliferos gerentibus et staminibus stigmatibus exsertis.

*Holotype*: R.M. Barker 415, 5.v.1983, Kapalga, road to airstrip (AD); *isotypes*: NSW, DNA, 1 to be distributed.

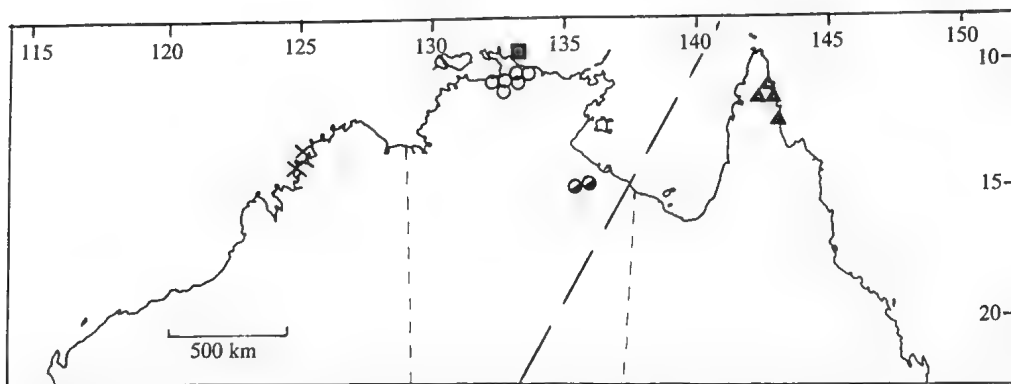


Fig. 34. Distribution of *Dicliptera* and *Peristrophe* species in Australia. ■ *D. australis*; ○ *D. arnhemica*; ◐ *D. aff. arnhemica* × *D. miscella*; ▲ ? *P. brassi*.

Decumbent sprawling herb, 20-40 cm high. *Branches* 5-6-angled, glabrous or with longitudinal rows of downturned eglandular hairs along angles, extending onto petioles and leaves. *Leaves* with petiole 2-7 (-30) mm long; blade ovate to oblong, 2-6.5 x 0.4-3 cm, smaller higher up, attenuate at base, entire, acuminate or mucronate, more rarely acute or obtuse at apex, both leaf surfaces glabrous, very sparsely ciliate or covered with similar hairs to those on angles of stem. *Inflorescences* in all upper axils, compact clusters, often subtended by pair of leaves, those at successive nodes not overlapping, c. 7-8 sessile bracteate clusters; spines subtending bracteate clusters c. 7-8 mm long, with tiny, moderately dense eglandular hairs at base mixed with occasional longer, slender, flexuose eglandular hairs, particularly on keeled portion of spine; *bracteate clusters* consisting of 1-2 shortly pedunculate bract pairs, peduncles c. 1 mm long, with short glandular indumentum, sometimes also with longer, flexuose hairs; *bracts* orbicular, pairs of similar size or one of pair smaller, 6-9 x 6-9 mm, obtuse to truncate at base, cuspidate at apex, apical spine on both bracts 1.5-2 mm long, externally with mixture of short glandular and eglandular hairs, former rarely absent (Barker 585), mixed with long, slender, flexuose multicellular hairs at least at base and sometimes extending all over; flowers chasmogamous. *Bracteoles* c. 2 mm long, with short eglandular pubescence mixed with occasional glandular hairs. *Calyx* segments c. 3.5 mm long, similar indumentum to bracteoles. *Corolla* tube white, lobes deep pink, upper lip with darker striations or rarely (see Note 2) blotches, externally with fine glandular and eglandular indumentum, internally glabrous, ridges decurrent from filaments glabrous; tube 5-8 mm long, throat 3-5.5 mm long, lobes 10-17 mm long, (McArthur River specimens somewhat smaller (see Note 2)). *Stamens* with deep pink filaments, far exserted with style; anther cells 1.2-1.8 mm long, yellow or deep purple, inserted at equal levels, parallel and curved back at either end to give adaxial (i.e. surface with sutures) surface convex appearance. *Ovary*: style c. 13-15 mm long, pink to purple. *Capsule* with glandular hairs at apex and on base, lacking eglandular hairs, 2-seeded. *Seeds* c. 2.3 mm wide, smooth, black with age. Fig. 31 J-K.

### Distribution

*D. arnhemica* is known only from Arnhem Land in the Northern Territory, with two collections having affinities to the species from McArthur River further south.

### Ecology

It has been found on the margins of fringing forest in sandy or loamy soil in "open *Allosyncarpia* forest" in "rocky areas" on Nourlangie Rock and on river banks. Flowering occurs between May and June, with collections later than this date usually fruiting only.

### Notes

1. The relationship of this species with *D. australis* from Goulbourn Island needs to be established (see Note 1 under *D. australis*).

2. Specimens from McArthur River (Craven 4066 and R.M. Barker 585) possibly deviate sufficiently from typical *D. arnhemica* to deserve some status. They are not distinctly glandular on the bracts, the leaves tend to be longer petiolate and with a larger blade than in typical *D. arnhemica* and the flowers are smaller (tube 7-8 mm long, throat 1.5-2 mm long and lobes 6-8 mm long) with the upper lip blotched rather than striated. On the other hand the bracts do possess the typical flexuose hairs of *D. arnhemica*. Collections from the areas between Arnhem Land and McArthur River should help determine whether this material is a distinctive taxon or part of a cline.

### Specimens examined

NORTHERN TERRITORY: R.M. Barker 415, 5.v.1983, Kapalga, road to airstrip (AD); R.M. Barker 585,

14.v.1983, McArthur River, 12.4 km S of Cape Crawford on Tablelands Hwy (AD); *Basedow* 99, 1928, Arnhem Land (AD, K); *Craven* 4066, 3.vi.1976, Bank of the McArthur River (CANB, NT); *Craven* 6339, 4.vi.1980, 10.5 km ENE of Jabiru East (CANB); *Fox* 430, 15.v.1974, Mt Brockman (DNA); *Harley* 13750, 28.v.1973, Tin Camp Creek, c. 20 miles S of Nabarlek mining camp (CANB, NT); *Henry* 878, 4.viii.1973, Nourlangie Rock area (NT); *Lazarides* 9181, 4.vi.1980, 10.5 km ENE of Jabiru East (CANB); *Parker* 72, 22.v.1973, Nourlangie Rock (BRI, DNA, NT); *Pullen* 9481, 5.vi.1974, Babinji Crossing near Goomadeer, on the Oenpelli-Manngrida Road, c. 76 km E of Oenpelli, Arnhem Land (CANB); *Rankin* 2034, 20.iv.1979, Nabarlek (CANB, DNA); *Rice* 2719, 5.vi.1978, Magela Creek, Koongarra survey (BRI); *Telford* 7942 and *Wrigley*, 21.iv.1980, Gulungul Creek, mouth of Radon Gorge, 4 km WSW of Mt Brockman, Kakadu National Park (CBG); *Telford* 8049 and *Wrigley*, 23.iv.1980, Kakadu National Park, 6.5 km SSW of Mt Brockman (CBG).

## 6. *Dicliptera australis* (Nees) R.M. Barker, comb. nov.

*Brochosiphon australis* Nees in A. DC., Prodr. 11 (1847) 492, BASIONYM.

*Holotype*: A. Cunningham s.n., s. dat. Goulbourn Island (K); *possible isotypes*: A. Cunningham 193, 1818, South Goulbourn Island (K—2 sheets, BM, NSW).

Decumbent, spreading herb, to 30 cm high. *Branches* 4-6-angled, glabrous. *Leaves* with slender petioles to 4 mm long; blade narrowly elliptic, 2-4 x 0.25-0.7 cm, attenuate at base, entire, acute or more rarely, obtuse at apex, leaf surfaces almost glabrous apart from very sparse, stout 2-3-celled eglandular hairs on upper surface and sometimes sparsely on margins. *Inflorescences* in upper axils, compact clusters subtended by pair of leaves, those at successive nodes not overlapping, consisting of 1-3 (-6) bracteate clusters; spines subtending bracteate clusters c. 4-6 mm long, glabrous apart from stout, eglandular hairs along margins of keeled portion; *bracteate clusters* consisting of 1-2 more or less sessile bract pairs; *bracts* ovate, one of pair smaller, 4.5-10 x 1.5-6 mm, the larger 7-14 x 3.5-9 mm, shortly attenuate at base, cuspidate at apex, apical spine on both bracts 1.5-2 mm long, externally more or less glabrous apart from appressed eglandular hairs along margins, or younger bracts sometimes with dense cover of short, erect glandular hairs all over; flowers all ? chasmogamous. *Bracteoles* c. 2 mm long, with short eglandular hairs. *Calyx* segments c. 4 mm long, with dense glandular pubescence all over. *Corolla* colour unknown, probably tube white, lobes pink-purple, markings unknown, externally with mixture of eglandular and glandular hairs, internally glabrous, ridges decurrent from filaments glabrous; tube and throat c. 15 mm long, lobes c. 6 mm long. *Stamens* with filament colour unknown, anther cells only just exerted from throat, c. 1.8 mm long, colour unknown, inserted at slightly unequal levels. *Ovary* and *capsules* unknown.

### *Typification*

There is only one specimen in K bearing the annotation *Brochosiphon australis* in Nees von Esenbeck's hand and this specimen must be the holotype. Four other collections by Cunningham from South Goulbourn Island (rather than Goulbourn Island of the holotype) are also present in K (2 sheets), BM and NSW but lack inscriptions by Nees. These appear to be from a similar gathering to that of the holotype and they have been treated here as probable isotypes of *Brochosiphon australis* (See Note 2).

Unfortunately all four sheets possess very little floral material and no capsules and seeds. The material has always been treated by workers subsequent to Nees as *Dicliptera glabra* (*D. armata* of this work), but there is enough floral material present on the specimens to indicate that by its equally inserted anther cells and more or less included stamens, that it cannot be placed there (see Note 1).

### Distribution

The only collections known of *D. australis* are those of Cunningham from Goulbourn Island (Fig. 34). The holotype is labelled merely as Goulbourn Island while the other four collections are annotated as South Goulbourn Island, but these appear to be synonymous (Note 3).

*Ecology:* Nothing is known of this species.

### Notes

1. Further collections from Goulbourn Island are required to establish the status of this species and its relationship to the species from Arnhem Land, *D. arnhemica*. Both species are unique in Malesia in possessing equally inserted anther cells, but they differ from each other by the inclusion of these anthers within the throat of the corolla in *D. australis* and their prominent exsertion in *D. arnhemica*. Apart from this, they vary in bract indumentum and apparently the number of bract pairs per inflorescence, this apparently being much reduced in *D. australis*. Very little floral material of *D. australis* has been seen, and no capsules and seed.

2. Nees von Esenbeck (1847a) described the new genus *Brochosiphon* to encompass the Goulbourn Island material of Cunningham. He recognised it as different from *Dicliptera* by the included stamens and stigma (discussed above) and also the equally inserted anther cells. Another difference, at least from all Australian *Dicliptera* species except *D. arnhemica*, is the apparent lack of any cleistogamous flowers within the inflorescences. In all other respects the material identifies very closely with *Dicliptera* and there seems to be no justification for maintaining it as a separate genus.

3. The Goulbourn Islands were visited on several occasions by Cunningham on the voyages he made with King in his surveys of the north-west coast of Australia. These islands were apparently a watering place (McMinn 1970) and it seems were visited on at least the first three King voyages. The probable isotypes have been labelled very clearly as having been collected in 1818 from South Goulbourn Island on what was the first of King's surveys, but the holotype merely has Goulbourn Island, with no date. Modern maps treat South Goulbourn Island and Goulbourn Island as the same place, but whether the two were considered to be the same in King's surveys has yet to be established.

### Specimens examined

NORTHERN TERRITORY: *A. Cunningham s.n.*, s. dat. Goulbourn Island (K); *A. Cunningham 193*, 1818, South Goulbourn Island (K—2 sheets, BM, NSW).

## 20. PERISTROPHE Nees

This genus is newly recorded from Australia on the basis of a single new and atypical species (see Note 1) from Cape York Peninsula. At this stage it is only doubtfully referred to *Peristrophe*.

**Peristrophe** Nees in Wallich, Pl. Asiat. Rar. 3 (1832) 112; Nees in A. DC., Prodr. 11 (1847) 492; Clarke in Hook. f., Fl. Brit. India 4 (1885) 554; Clarke in This.-Dyer, Fl. Trop. Africa 5 (1900) 242; Clarke in This.-Dyer, Fl. Cap. 5 (1912) 84; Ridley, Fl. Malay Penins. 2 (1923) 609; Bremek., Nederl. Adak. Wetensch., Verh. (Tweedie Sect.), 45 (1948) 29; Backer, Fl. Java 2 (1965) 581.

*Type species*: not designated (see Typification).

*Justicia* p.p. auctt. prior to Nees (1832); not applied to Australian species.

*Dianthera* p.p. auctt. prior to Nees (1832); not applied to Australian species.

Erect herbs with cystoliths. *Leaves* sessile or petiolate, each opposite pair connected by transverse ridge. *Inflorescence* of 2-3 flowers within an involucre consisting of 2 free, often unequal, outer bracts; involucre paired or cymose, terminal or axillary on long peduncles, bibracteate at base of peduncle. *Bracteoles* smaller than and enclosed by involucre bracts. *Calyx* with 5 narrow, acute, equal segments. *Corolla* 2-lipped; tube (not in Australia) twisted through 180°, narrow, widened into throat apically; upper lip entire or emarginate; lower lip 3-lobed, without palate. *Stamens* 2, inserted in corolla throat, exerted from corolla; filaments hairy or glabrous; anther cells 2, inserted at unequal levels, without appendages or hairs. *Ovary* with 2 ovules per cell; style long; stigma bilobed. *Capsule* clavate, base without seeds, expanded portion with 2 prominent seed-bearing hooks per cell. *Seed* 4 per capsule, more or less orbicular, compressed, tuberculate, glabrous. Fig. 35 A-F.

### Typification

A lectotype species apparently needs to be chosen for this genus from the eight Indian species described by Nees (1832) in the protologue. Bremekamp (1957) refers to *P. tinctoria* Nees (= *P. bivalvis* (L.) Merrill, see Wood et al. 1983) as type species of the genus, but in the entry for 'Index Nominorum Genericorum' (Bremekamp 1979) for which he was responsible, it is indicated that no lectotype has been designated. No reason was given in the earlier paper for choosing *P. tinctoria* as the lectotype.

The correctness of Bremekamp's choice needs confirmation. Of the eight species described by Nees, a number require investigation as to their true names and generic placement. Most have in synonymy names which are earlier, and one of the eight species, *P. pubigera* Nees, was transferred back to *Justicia* by Clarke (1885). Lectotypification of the genus is best left to a reviser of the genus or at least of the Indian species.

### Distribution

*Peristrophe* is a genus of 15-20 species found in Africa, India, Asia and Malesia. A single species doubtfully referred to *Peristrophe*, is found in Australia on Cape Yorke Peninsula. There is an old collection of an introduced species from New South Wales, but there is no evidence of this being naturalised.

### ?*Peristrophe brassii* R.M. Barker, sp. nov.

Species nova, a specibus omnibus differt a filamentis glabris, infero labio profunde trilobo et tubo corollae non torto.

*Holotype*: Gittins 1076, viii.1965, Kennedy Road, Mt Tozer (BRI); *isotypes*: (NSW, K).

Erect or ascending herb 30-100 cm tall, sometimes rooting at lower nodes. *Branches* more or less 6-angled, green with longitudinal white stripes, glabrous except for few sparse eglandular hairs at nodes. *Leaves* more or less sessile, jointed at base; blade linear-lanceolate, ovate, 3.3-7.5 x 0.2-1.5 cm, acute or obtuse at base, entire, acute to obtuse at apex, upper surface with very sparse eglandular hairs, lower surface paler (in *Clarkson 2425*, red) and glabrous, both surfaces with linear cystoliths. *Inflorescence* comprising single or paired long pedunculate cymes arising in each of upper axils. *Bracts* 2 at base of peduncle, linear-lanceolate, 2-4 mm long, glabrous lower down, with similar indumentum to peduncle higher up. *Peduncle* 4-20 mm long, with mixture of glandular and eglandular hairs. *Involucral*

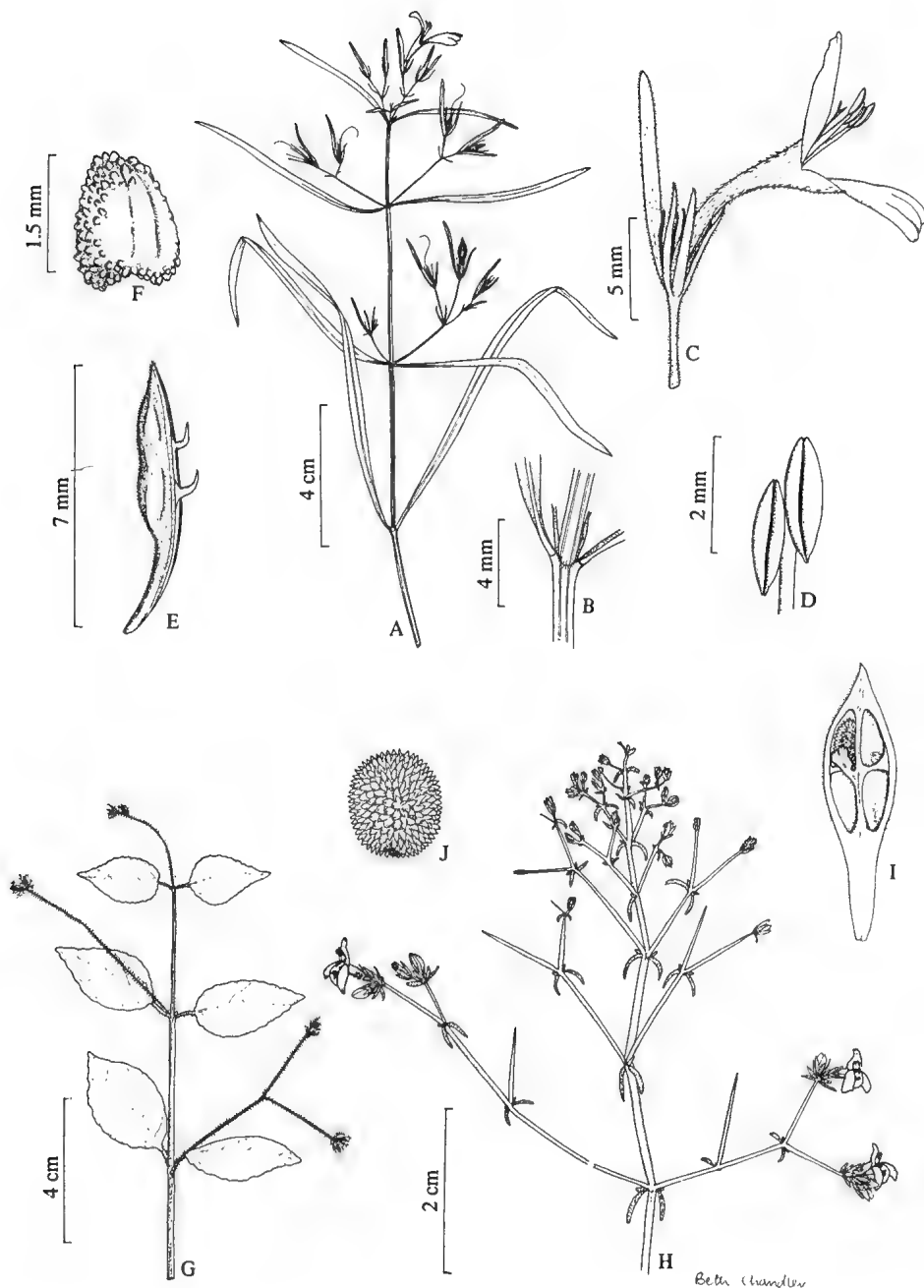


Fig. 35. A-F, *?Peristrophe brassi* R.M. Barker. A, habit; B, abscission zone at base of leaves, opposite leaves joined by transverse ridge; C, flower subtended by unequal involucre bracts, bracteoles and calyx. Corolla tube not twisted through 180°; D, unequally inserted anther cells; E, lateral view of half a capsule without seeds but with seed-bearing hooks; F, seed (Gillies 1076). *Rhaphidospora*. G, *R. cavernarum* (F. Muell.) R.M. Barker, habit (Thozet 485: holotype). H-J, *R. bonneyana* (F. Muell.) R.M. Barker. H, habit (Gordon 148); I, half capsule, ventral view, with one seed still present; J, seed (Bonney MEL 86988).

*bracts* linear-lanceolate, unequal, indumentum of eglandular and glandular hairs usually all over, the larger 7-18 x 2 mm, smaller 4.3-10 x 0.8 mm, usually enclosing 2-3 flowers, one often rudimentary. *Bracteoles* smaller than involucre bracts, similar in shape and indumentum, slightly unequal. *Calyx* segments 4-6 mm long, similar indumentum to bracteoles, involucre bracts and peduncle. *Corolla* white with red, pink or purple spots in throat; tube 9-10 mm long, not twisted through 180°, hairy on both surfaces; lobes 6.5-10 mm, free for over ½ their length, hairy outside, glabrous on inner surface. *Stamens* with filaments c. 5 mm long, glabrous; anther cells 1.3-1.7 mm long, linear. *Ovary* ellipsoid; style 1.3-1.5 mm long, few sparse hairs at base; stigma at same height as stamens. *Capsule* 8-10 mm long, densely covered by eglandular and glandular hairs. *Seed* c. 2 x 1.8 mm. Fig. 35 A-F.

### Distribution

?*P. brassii* is known only from Cape York Peninsula, northern Queensland. Fig. 34.

### Ecology

Collections from Tozer Gap were from "shrubby borders of gully rain forest", from Brown's Creek it was common on sandy floodbanks, from the north end of the Tozer Range it was in "bushy rainforest on slopes", and from the Chester River it was found in "*Melaleuca viridiflora* woodland". Altitude is recorded from 60-200 m. All specimens collected were flowering and (except *Brass* 19338) fruiting and so the flowering time is presumably June to August.

### Notes

1. The Australian material of *Peristrophe* has been compared with a number of Malesian species of *Peristrophe* but remains unique in the possession of glabrous filaments, a deeply 3-lobed lower lip and a lack of twisting through 180° of the corolla tube. In habit it very closely resembles *P. paniculata* (Forsskål) Brummitt, differing from it by the characters mentioned above, by the presence of glandular hairs on the peduncle and involucre bracts, linear anthers and possession of usually lanceolate leaves.

Two other species, *P. hyssopifolia* (Burm. f.) Merr. and *P. acuminata* Nees (possibly synonymous) are variable weedy species recorded from Java and India/Malay Peninsula respectively. The two specimens of *P. hyssopifolia* seen from Leiden differ from the Australian material by their lack of glandular hairs on the floral parts, and by their petiolate leaves as well as their hairy filaments. From descriptions *P. acuminata* would also differ in these characters and both species have only very shortly 3-lobed lower lips.

There are two species of *Peristrophe* recorded from New Guinea, *P. bivalvis* (L.) Merrill from Vogelkop and *P. keyensis* Warb. From descriptions the Australian material differs from *P. bivalvis* by its glabrous filaments and deeply 3-lobed lower lip and from *P. keyensis* by its much smaller flowers.

However, it remains a possibility that the material does not represent *Peristrophe* at all. Balkwill (pers. comm. 25.x.1985) who has revised the South African *Peristrophe* species suggests that it might perhaps belong to *Rhinacanthus*. As he points out the broad and deeply 3-lobed lower lip is more reminiscent of that genus and it would agree in stamen morphology. However, most *Rhinacanthus* species have a very short and narrow, porrect upper lip and none of them are subtended by involucre bracts which exceed the flower. *Rhinacanthus* species also appear to differ in their seed surface morphology. Pollen of species in the two genera is very similar.

2. The species is named after Mr Leonard Brass, a prolific and meticulous collector of Cape Yorke Peninsula and adjacent New Guinea. He recognised the resemblance of the species to *Peristrophe*.



*Specimens examined*

QUEENSLAND: *Brass* 19338, 28.vi.1948, Tozer Gap, Tozer Range (CANB); *Brass* 19367, 29.vi.1948, Tozer Range, north end (CANB, G, L, K); *Brass* 19577, 14.vii.1948, Brown's Creek, Pascoe River (CANB, G, L); *Clarkson* 2199, 8.vi.1978, Southern end of Temple Bay in upper reaches of an unnamed creek between Glennie and Hunter Inlets (BRI); *Clarkson* 2425, 28.vii.1978, Chester River Camp Site (BRI); *Gittins* 1076, viii.1965, Kennedy Rd, Mt Tozer (BRI, K, NSW); *Hind* 301, 19.viii.1973, Brown's Creek, Kennedy Rd (en route to Portland Road), Cape York Peninsula (NSW); *Young* 24, vii.1923, Temple Bay (BRI).

***Peristrophe speciosa* (Roxb.) Nees in Wallich, Pl. Asiat. Rar. 3 (1832) 113.**

A second species of *Peristrophe* is represented in MEL material. Only a single collection exists and it was obviously made some time in the 1800's as it bears a blue Baron Ferd. von Mueller label. The specimen can be referred to *P. speciosa* (Roxb.) Nees, a native of Bengal, already in cultivation in Britain and the Calcutta Botanic Garden, in the early 1800's. There is no precise locality data given on the sheet and it is probably best treated as an introduced species. The specimen matches well the illustration in 'Curtis's Botanical Magazine' (Hooker 1827, t. 2722), particularly with respect to the spatulate bracts, and it also matches non-Australian material of this species in MEL, and material cultivated under this name in the Adelaide Botanic Garden.

*Specimen examined:*

Moore s.n., s. dat. N.S. Wales (MEL 100827).

**Non-Australian species of *Peristrophe* seen**

1. *P. hyssopifolia* (Burm. f.) Merr.

JAVA: *Anon. s.n.*, s. dat. Java (L 6446: 32 & 33).

2. *P. paniculata* (Forsskål) Brummitt

INDIA: *Kamra s.n.*, ix.1952, Delhi (AD 97710981); *Venkatesh s.n.*, x.1958, Delhi, University Campus (AD 96032111).

3. *P. lanceolaria* (Roxb.) Nees

INDIA: *Wall. Cat.* 2463a, 1830, Sillet, India (K: syntype).

**21. HYPOESTES Solander ex R. Br.**

The genus *Hypoestes* was first described by Robert Brown (1810), based on a manuscript name of Solander. He described the species *H. floribunda* from Australia in this account and said that other species belonging here were *Justicia fastuosa*, *J. forskalei*, *J. purpurea*, *J. aristata* and *J. serpens* as enumerated by Vahl (1791).

Nees von Esenbeck (1847a) accepted *H. floribunda* R. Br. for Robert Brown's collection from Queensland, but Cunningham and Armstrong material which he saw from north-west Australia he ascribed to var.  $\beta$  of his newly described species, *H. laxiflora*, from Java and the Philippines.

Bentham's (1868) treatment recognised all of the Australian material as one species, but he stated:- "The following forms of this very variable plant might be distributed according to the inflorescence into three principal varieties or perhaps species, . . . Densiflora, . . . Paniculata. (and) Distans". The first was split into two varieties, 'canescens and pubescens', and the second also had within it a variety 'angustifolia', as well as including syntypes of *H. floribunda*.

Subsequent authors have treated 'densiflora', 'paniculata' and 'distans' as either varieties or species. F.M. Bailey (1913) raised 'densiflora' and 'paniculata' to species rank and subsequently Domin (1929) also raised 'distans' to a species. On the other hand Ewart & Davies (1917) treated the three as varieties of *H. floribunda*. All must be regarded as validly published even though they lack descriptions, as the citation of Bentham as the author is an indirect reference to his validly published description (see ICBN, Art. 32). However, because 'paniculata', contains the type of R. Brown's *H. floribunda*, it must be illegitimate whether described at the species or varietal level. It is questionable too, whether 'densiflora' can be described as a variety as Bentham described varieties within it. The question of its use at varietal level, however, does not arise as it is predated by one of its own varieties (see synonymy of var. *pubescens*).

The only other *Hypoestes* species to be described from Australia is a Western Australian species, *H. suaveolens* described from the Kimberleys by Gardner in 1923.

Outside Australia *H. floribunda* extends to New Guinea with at least two varieties, one of them Australian and the other new. According to Merrill (1923) the species also occurs in the Philippines.

The type of *H. rosea* Decne. from Timor approaches closely specimens of *H. floribunda* from northern Australia, differing only in the larger, longer-pedicelled involucre arranged on short branches arising from the axils. *H. rosea* is possibly the earliest name\* available for a species which in Malesia is usually referred to as *H. decaisneana* Nees. This species is recognised as extremely variable (Backer 1965) and was placed by Clarke (1885), together with *H. laxiflora* Nees (a Philippines species), in synonymy under an Indian species, *H. malaccensis* Wight. This last name was published in 1850 and hence is predated by the two Nees epithets, but it should be noted that Wight's illustration of *H. malaccensis*, apart from the incorrect orientation of the corolla lips, closely approaches *H. rosea* Decne. The type specimen of *H. laxiflora* Nees which has been examined differs from the Australian material by the extremely long, thin, tapering bract apices which are densely glandular hairy, but whether this difference is sufficient to warrant species delimitation is not known. *Hypoestes* needs to be revised throughout Malesia to determine the relationships of all of these species, both to each other and to *H. floribunda*. At this stage the epithet 'floribunda' is the earliest of any of those mentioned that can be applied to Australian material, but should the Indian and Australian *Hypoestes* be found to be conspecific then it is possible that one of the *Justicia* species mentioned under *Hypoestes* by Brown (1810) might provide an earlier name.

In this work the variability in *Hypoestes floribunda* in Australia has been treated at the varietal level, since named varieties already existed in the literature. It was felt that it was better to conform with this infraspecific ranking since only Malesian-wide revision can determine relationships of the Australian material with such species as those mentioned above.

Within Australia and New Guinea 11 varieties have been recognised, most of which intergrade to varying extents where they overlap geographically. In New South Wales and south-east Queensland there occur three varieties characterised by two involucre at each node while those in the other varieties from northern Queensland, Northern Territory, Western Australia and New Guinea all possess a single involucre. The varieties are further defined on the basis of the arrangement of their involucre in the inflorescence and indumentum type on leaves, involucre, corollas, filaments and capsules.

In Western Australia a new species, *H. sparsiflora* has been described as it shows no intergradation with the rest of the *H. floribunda* complex. The previously recognised *H. suaveolens* Gardner has been reduced to a variety of *H. floribunda* as it does not differ markedly from the rest of that complex, except by its hair covering. A group of collections from the Mitchell Plateau have not been separated formally as the pattern of variation in

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\**H. rosea* Decne. is however predated by the West African *H. rosea* P. Beauv., Fl. Oware 2 (1818) 66, t. 100, and is therefore illegitimate.

*H. floribunda* in the Kimberley region is at present not well known. In addition, var. *varia* and var. *cinerea* predominantly from northern Northern Territory are somewhat polymorphic and there appear to be distinctive taxa within them which have been discussed but given no formal status.

**Hypoestes** Solander ex R.Br., Prodr. (1810) 474; Nees in A. DC., Prodr. 11 (1847) 501-510; Benth., Fl. Austral. 4 (1863) 553; Benth. & Hook. f., Gen. Pl. 2 (1876) 1122; Lindau in Engl. & Prantl., Nat. Pflanzenfam. IV, 3b (1895) 333.

*Type: H. floribunda* R. Br. (Australia).

Herbs or subshrubs, with cystoliths. *Branches* often obscurely angled or ribbed, usually with constriction just above node. *Leaves* petiolate, connected across node by faint transverse ridge. *Inflorescence* terminal or axillary, consisting of involucre of fused bracts arranged in short or long, sometimes 1-sided panicles or spikes or in condensed axillary clusters; each involucre subtended by 2 small deltoid or leaflike bracts at base,\* pedunculate or sessile, enclosing at least 2-4 flowers, one often rudimentary, the rest at various developmental stages. *Involucre* consisting of 4 bracts, outer 2 fused at least part of way from base (in Australia) to form a cylinder, inner (bracteoles) 2 inserted at right angles to outer bracts, free from each other, fused by their midrib to fused part of outer bracts. *Calyx* segments 5, acute, equal, usually included in involucre. *Corolla* with tube narrow-cylindrical at base, tube twisted through 180°; limb 2-lipped, lower lip (true upper lip by twisting of tube through 180°) downturned or reflexed and more or less circinate, narrow, entire or slightly notched, upper lip (true lower lip by twisting of tube through 180°) wider and 3-lobed at apex, more or less erect, frequently with barred area (similar to palate of lower lip of *Rostellularia* and *Sarojusticia*). *Stamens* 2, inserted at top of corolla tube, exserted; anthers 1-celled, cells basally attached, not awned. *Ovary* with 2 superposed ovules per cell; style shortly 2-lobed at apex. *Capsule* clavate, seedless at base, 2 prominent seed-bearing hooks per valve. *Seed* usually 4 per capsule, glabrous, compressed, more or less orbicular or oblong, smoothly tuberculate, each tubercle slightly dimpled. Fig. 36.

### Distribution

*Hypoestes* is a genus of approximately 70 species from tropical and southern Africa, India, China, Malesia and Australia. It is in need of revision over its whole range, and the estimate of species numbers is only very approximate. In Australia there are two species recognised, one of these, *H. floribunda*, being extremely polymorphic and the other, *H. sparsiflora*, newly described. The former extends into Malesia.

### Key to species of *Hypoestes* in Australia

- 1a. Involucres 3-3.5 mm long. Calyx exceeding involucre bracts at flowering. Involucres very distant, never overlapping. Peduncles of involucre 1.5-16 mm long. Corolla white with upper lip yellow tinged. Straggly diffuse subshrub ..... 1. *H. sparsiflora*
- 1b. Involucres more than 3.5 mm long. Calyx usually shorter than involucre bracts at flowering. Involucres often overlapping or almost so, never far apart. Peduncles of involucre lacking or up to 3 mm long. Corolla pink or purple, sometimes white with purple markings. Erect subshrub . . . . 2. *H. floribunda*

### 1. *Hypoestes sparsiflora* R.M. Barker, sp. nov.

Species nova, a *H. floribunda* differt involucris sparsissimis in paniculis, involucris parvioribus, pedunculis, longioribus, bracteis binatis connatis non nisi longitudine quarta-tertia basi, plerumque lobis calycis bracteis involucratatis excedentibus.

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\*Referred to as "involucre subtending bracts" in the descriptions, and grading into leaves.

*Holotype*: Wilson 10749, 14.v.1972, Augustus Island, Bonaparte Archipelago (PERTH); *isotype*: (L, n.v.).

Straggly, slender, perennial herb or subshrub, to 1 m high. *Branches* sometimes with dense appressed eglandular hairs, sometimes mixed with short glandular hairs in younger parts, sometimes glabrous apart from few eglandular hairs in younger parts. *Leaves* scattered, petioles 3-7 mm long; blade linear-lanceolate to ovate, 2-5.5 x 0.2-2 cm, eglandular hairs sometimes confined to petiole, midrib, main lateral veins and margins, sometimes spread sparsely over entire lower and upper surface. *Inflorescence* long, very slender, terminal panicle of sparse, never overlapping involucre, distance between two lowermost involucre 8-37 mm; rachis, throughout panicle, covered by dense, short, ?glandular hairs mixed with few to dense, longer eglandular hairs, upper parts bearing much longer, conspicuously glandular hairs; involucre subtending bracts intergrading with leaves, linear to very narrowly deltoid, 1-2 mm long, similar indumentum to rachis. *Involucre* 3-3.5 mm long, sessile or on peduncles 1.5-16 mm long; outer bracts joined for ¼ to 1/3 of their length, similar indumentum to rachis, always with the conspicuously glandular hairs; inner bracts similar in length and indumentum to involucre. *Calyx* segments exceeding involucre at flowering, glandular hairs mixed with eglandular on outer surface. *Corolla* white with pale yellow tinge on upper lobe, externally covered with short glandular and eglandular hairs of equal length, internally glabrous except for sparsely pubescent ridges decurrent from filaments, tube 5-9 mm long, lobes c. 20 mm long. *Stamens*: filaments c. 10 mm long, shortly and densely pubescent along abaxial surface, glabrous above, anthers 2 mm long, purple. *Ovary* glabrous; style 20-25 mm long. *Capsule* 7-10 mm long, well exerted from bracts, short upright eglandular hairs, rarely mixed with subsessile glandular hairs (George 12819), on expanded portion. *Seed* c. 2 mm long. Fig. 36 A, F, G.

### *Distribution*

*H. sparsiflora* is known only from the Bonaparte Archipelago region of north-west Western Australia. Fig. 37.

### *Ecology*

The only records are from dense forest, from a "scree slope", from a "rocky sandstone gully" and from "shallow pockets of soil of gorge wall". Flowering occurs between May and August.

### *Notes*

The capsules in *George 12819* and *Wilson 10749*, the only ones seen, vary not only in indumentum, but also in shape, the two specimens having respectively an acuminate and acute apex. More collections of this very distinctive taxon are necessary to determine the extent of variation within populations.

### *Specimens examined*

WESTERN AUSTRALIA: *Cunningham 171*, (p.p.), 1820, Montagu Sound (BRI p.p., K); *George 12819*, 29.viii.1974, near Gariyeli Ck, Prince Regent R. Reserve (BRI — 3 sheets, PERTH); *Kenneally 2133*, 25.viii.1974, below Python Cliffs, Marigui Promontory, Prince Regent R. Reserve (PERTH); *Kenneally 8921*, 4.vi.1984, unnamed tributary, 19 km SE of mouth of Prince Regent River (PERTH); *Wilson 10749*, 14.v.1972, Augustus Is., Bonaparte Archipelago (PERTH).

2. *Hypoestes floribunda* R. Br., Prodr. (1810) 474; Nees in A. DC., Prodr. 11 (1847) 509; Bauer in Endl., Iconogr. Gen. Pl. (1840) pl. 105; Prodr. 11 (1847) 509; Benth., Fl. Austral. 4 (1868) 554; F. Muell., Fragm. Phyt. Austral. 7 (1869) 40; F. Muell., Fragm. Phyt. Austral. 11

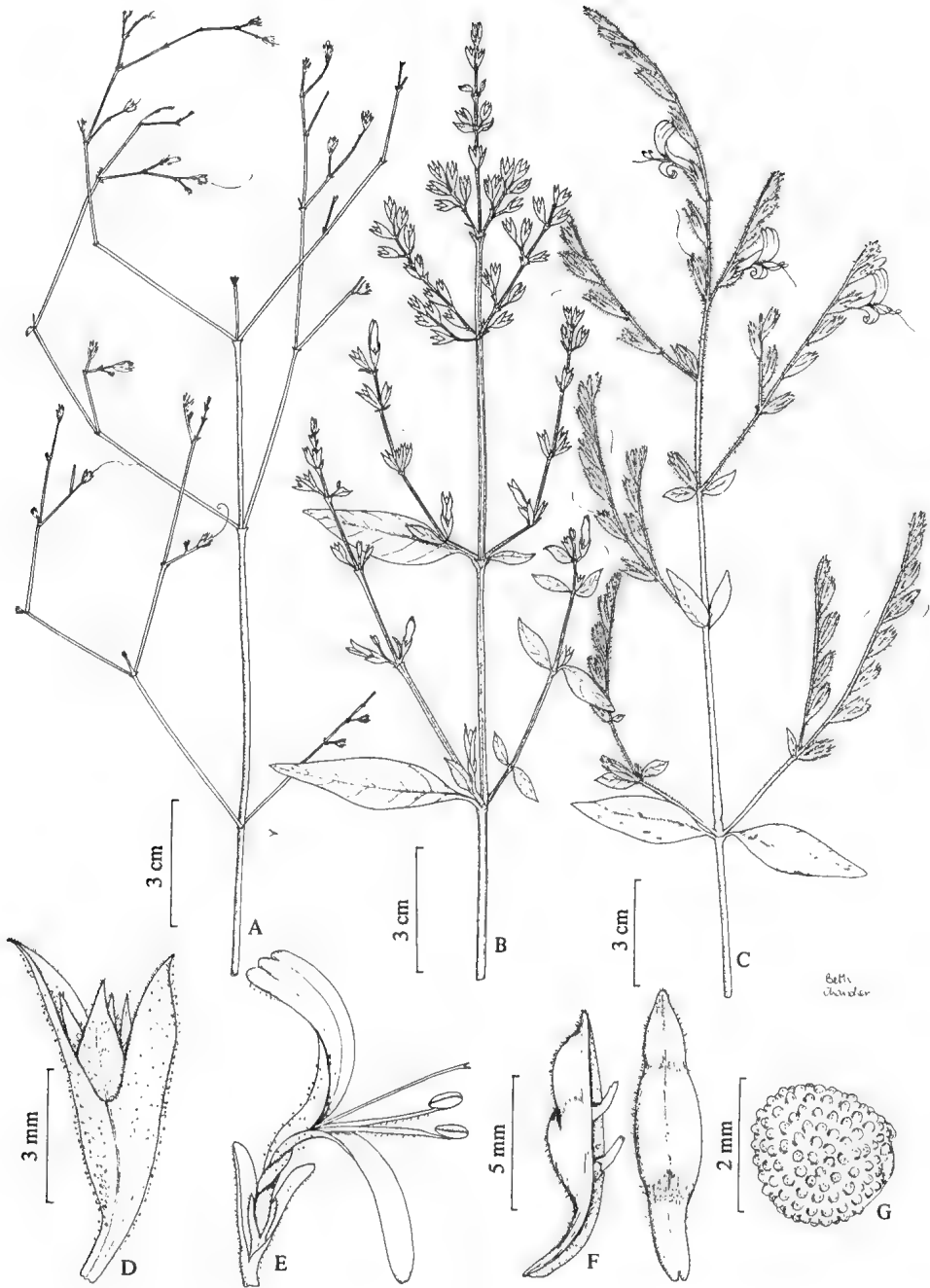


Fig. 36. *Hypoestes*. A, F, G, *H. sparsiflora* R.M. Barker. A, habit (Kenneally 2133); F, capsule showing lateral and dorsal views; G, seed (Wilson 10749). B, D, *H. floribunda* var. *floribunda*. B, habit (Blake 5842); D, involucre of two outer bracts fused for half their length and with two inner bracts inserted at their join by their midrib — calyx lobes also visible (Story & Yapp 94). C, *H. floribunda* var. *suaveolens* (Gardner) R.M. Barker, habit (Kenneally 8109). E, *H. floribunda* var. *yorkensis* R.M. Barker, flower showing twisting of the tube through 180° (Clarkson 4557)

(1878) 18; F. Muell., Syst. Census Austral. Pl. (1882) 99; F. Muell., Sec. Syst. Census Austral. Pl. (1889) 168; F.M. Bailey, Qld Fl. 4 (1901) 1148; F.M. Bailey, Compr. Cat. Qld Pl. (1913) 374 p.p.; Maiden & Betche, Census of N.S.W. Pl. (1916) 185; Ewart & Davies, Fl. N. Terr. (1917) 252; C.A. Gardner, Enum. Pl. Austral. Occid. (1931) 119; J.S. Beard, W. Austral. Pl. 2nd edn (1970) 119; J. Green, Census Vasc. Pl. W. Austral. (1981) 95; Jacobs & Pickard, Pl. N.S. Wales (1981) 61; R.M. & W.R. Barker in Morley & Toelken, Fl. Pl. Australia (1983) 283, pl. 171c.

*Lectotype here designated: R. Brown 2949, 3.ix.1802, Shoalwater Bay, Conical Pine Hill (BM). isolectotypes: (BM: 2 sheets, K p.p.); probable isolectotypes: (K p.p., K, MEL 56674, BRI 141421, G-DC. — microfiche AD).*

*H. floribunda* R. Br. "1. *densiflora*" Benth., Fl. Austral. 4 (1868) 554. — *H. densiflora* (Benth.) F.M. Bailey, Compr. Cat. Qld Pl. (1913) 374.

*Lectotype here designated: Mueller s.n., s. dat., Moreton Bay (K). ?Isolectotype: ?Mueller 25, vii.1855, Brisbane River (MEL), see also under var. pubescens. Syntypes (belonging to var. pubescens in this treatment): Anon. (?Bowman) s.n., s. dat., Nerkool Ck (MEL 601954); Cunningham 104, viii.1828, Brisbane River (K); Dallachy s.n., s. dat., Rockingham Bay (K, MEL 601950); Anon. (?Dallachy) s.n., 21.v.1860, Rockingham Bay (MEL 601945); P. O'Shanesy 212, 29.vi.1865, Salt Water Creek (MEL 601947 p.p.); P. O'Shanesy 16, 17.x.1866, River Stone (MEL 601947 p.p.). Syntypes belonging to var. floribunda in this treatment: Anon. 296, s. dat., without locality (MEL 601953); Bowman 149, ?1862, without locality (MEL 100795); Thozet 466 or s.n., s. dat., (Crocodile Creek) Rockhampton (MEL 601951 p.p., MEL 601952, MEL 100792, Kp.p.). Possible syntype: O'Shanesy 80, 1.iv.1867, Table Mountain (MEL). Syntypes belonging to var. floribunda — var. velutina: Dallachy s.n., ?1865-6, Edgecombe Bay (MEL 601946); Fitzalan s.n., s. dat., Port Denison (Kp.p., MEL 601949, MEL 601956); Fitzett s.n., s. dat., Port Denison (MEL 601955). Possible syntypes: Fitzalan s.n., s. dat., Port Denison (MEL 100823, 100825); Anon. (?Dallachy) s.n., s. dat. Queensland (K p.p.); Anon. s.n., s. dat. (MEL 601951 p.p.). Syntype belonging to var. varia: Martin 34, s. dat., Lagrange Bay (MEL).*

*H. floribunda* R. Br. "2. *paniculata*" Benth., Fl. Austral. 4 (1868) 554, nom. illeg. — *H. paniculata* (Benth.) F.M. Bailey, Compr. Cat. Qld Pl. (1913) 374, (see introduction to genus p. 195, and typification and synonymies of var. *floribunda*, var. *canescens* and var. *varia*).

*H. floribunda* R. Br. "3. *distans*" Benth., Fl. Austral. 4 (1868) 554. — *H. distans* (Benth.) Domin, Biblioth. Bot. 89 (1929) 606: see var. *distans*.

*H. laxiflora* Nees in A. DC., Prodr. 11 (1847) 508 p.p. (only with respect to Australian specimens collected by Armstrong and Cunningham included under var.  $\beta$ ).

*H. moschata* F. Muell., Select Extra-trop. Pl. 8th edn (1891) 529; F. Muell., Vict. Nat. 8 (1891) 115 (name only); F. Muell., Select Extra-Trop. Pl. 9th edn (1895) 261; Ewart & Davies, Fl. N. Terr. (1917) 252. For typification see var. *varia*.

*H. australiensis* Lindau, Feddes Repert. 11 (1913) 123. For typification see var. *pubescens*.

*H. rosea* Decne., non P. Beauv., Fl. Oware & Ben. 2 (1818) 66, t. 100., Ewart & Davies, Fl. N. Terr. (1917) 252, nom. illeg.

*H. suaveolens* C.A. Gardner, Bull. For. Dept. 32 (1923) 91; Gardner, Enum. Pl. Austral. Occid. (1931) 119; J.S. Beard, W. Austral. Pl. 2nd ed. (1970) 119; J. Green, Census Vasc. Pl. W. Austral. (1981) 95: see var. *suaveolens*.

Perennial herbs or subshrubs, polymorphic in many characters (see varieties), with glabrous or variously hairy branches. *Leaves* petiolate, ovate or lanceolate, base usually attenuate, entire margin, acute to acuminate apices; midrib initially 2-ribbed on upper surface; indumentum lacking or leaves with glandular and/or eglandular hairs, often glabrescent. *Inflorescence* terminal or axillary, involucre paired or single at each node, arranged in spikes, panicles or dense axillary clusters through varying condensation of branches and reduction of leaves. *Involucres* sessile or pedunculate, two outer bracts ovate or lanceolate with acute apices, joined by margins for 1/3-2/3 of their length, glabrous or variously hairy; *inner bracts* (bracteoles) narrower, usually shorter than outer bracts, outer surface on the exposed portion with similar

indumentum to bracts, inside usually with long eglandular hairs at apex and margins, glabrous below. *Calyx* included in involucre, rarely exceeding it in fruit, eglandular or glandular hairs on outer surface and eglandular hairs on margins. *Corolla* rarely white throughout, usually with white tube and pink, mauve or pale purple lobes, sometimes with darker purple and/or white areas on upper lip; external surface usually with glandular (these lacking in var. *neoguineensis*) and longer eglandular hairs on lips and throat, internally glabrous but for pubescent ridges decurrent from filaments. *Stamens*: filaments broad, glabrous or more usually hairy, often purple; anthers yellow or purple. *Ovary* ellipsoid, glabrous; style long, glabrous. *Capsule* straw-coloured at base, pale to dark brown above, exerted from or included in involucre, glabrous all over or with eglandular, rarely mixed with glandular, hairs at apex. *Seed* yellow when immature, dark brown on maturity. Fig. 36 B-E.

### Typification

#### 1. *Hypoestes floribunda* R. Br.

Brown's unpublished manuscript refers to "Justicia nodosa No. 77 specimen" from Pine Hill, Shoal Water Bay, and so the specimen in BM which bears this annotation and the number 77, in Brown's hand is designated as lectotype of the species.

#### 2. *Hypoestes floribunda* "1. *densiflora*" Benth.

Of the numerous specimens cited by Benthham in the protologue, the Bowman, Fitzalan, Martin and Dallachy (not the collection from Rockingham Bay) collections disagree with Benthham's original description of "all nearly glabrous". They are all pubescent on the leaves and branches. This leaves Mueller's collections from Moreton Bay, Dallachy's Rockingham Bay collection and Thozet's Rockhampton collections for selection as lectotype. Although the Thozet collections are the most numerous of those cited, they differ from the protologue in having involucre of c. 3-4 mm long. According to Benthham (1868) they are 2-3 lines or 4.2-6.3 mm long, and the involucre in these Thozet specimens cannot be considered crowded as Benthham noted. Of the remaining material, that which best fits Benthham's description of involucre in "short dense spikes or clusters, chiefly axillary" is Mueller's collection from Moreton Bay. The material of this collection in K has therefore been designated the lectotype of *H. floribunda* 1. *densiflora* Benth.

#### 3. *Hypoestes floribunda* R. Br. "2. *paniculata*" Benth.

This taxon is under ICBN Art. 63 illegitimate as Benthham included Brown's collections which are the types of *H. floribunda*. Thus, the epithet when used as basionym at varietal (Ewart & Davies 1917) and species (F.M. Bailey 1913) level is also illegitimate.

### Key to varieties of *Hypoestes floribunda*

Users of this key will require a microscope or hand lens as it is reliant in some cases on indumentum characters. Indumentum is usually of three types, all three sometimes occurring on the one taxon. Eglandular hairs are extremely common, these usually only varying in shape and size. There are also very short, dense, erect hairs which appear to have a minute gland at the apex: these have been referred to as glandular in the key, although the gland is not obvious even under a magnification of 40x. In contrast to these are the usually longer and distinctly glandular hairs which in the descriptions have sometimes been referred to as 'large-topped' or conspicuously glandular because of the size of the apical gland.

The involucre (Fig. 36D), consist of two outer bracts fused to each other by their margins for part of their length and two inner bracts (bracteoles) which are fused by their midrib to the joint of the outer bracts; they house a number of flowers. The indumentum of the outer surface of the involucre is frequently diagnostic; use of the term outer surface refers both to the bract surface and the exposed outer surface of the inner bracts.

As most of the varieties are geographically definable their distribution is also given in the key. If capsules are absent from a collection then it will not always be possible to determine to which variety it belongs. Specimens intermediate between recognised varieties are discussed after one of the varieties, with cross-referencing where necessary.

- 1a. Filaments glabrous. Corolla only with eglandular hairs on the outer surface: tube 3-7 mm long; lobes 5-8 mm long. [Inflorescence a branched axillary spike, often 1-sided]. New Guinea ..... e. var. *neoguineensis*
- 1b. Filaments pubescent. Corolla with glandular and eglandular hairs on outer surface; tube 5-13 mm long; lobes 7-19 mm long ..... 2
- 2a. Rachis, outer surface of involucre and their subtending bract pairs with 0.7-1.4 mm long, slender eglandular hairs, easily visible with the naked eye (Kimberleys region of WA)..... k. var. *suaveolens*
- 2b. Rachis, outer surface of involucre and their subtending bract pairs, with eglandular hairs, if present, much less than 0.7 mm in length ..... 3
- 3a. Involucre two at each node, at some nodes appearing to be only one because of their unequal development, or the involucre clustered into groups of 4-8 in the axils, but still with paired involucre at each node ..... 4
- 3b. Involucre always one at each node, rarely condensed together to form a cluster (var. *canescens*) ..... 7
- 4a. Capsules with moderately dense glandular hairs at apex. [Young leaves with very short, dense, glandular hairs mixed with longer eglandular hairs (Mt Garnett and Stannary Hills area, Qld)] ..... c. var. *velutina*
- 4b. Capsules glabrous or with only very sparse eglandular hairs at apex ..... 5
- 5a. Calyx with long, very dense, matted eglandular hairs on outer surface. Involucre with moderately dense, short, downturned eglandular hairs all over outer surface ..... a. var. *floribunda* (Note 1c)
- 5b. Calyx with short glandular or scattered short eglandular hairs on outer surface. Involucre with very long, conspicuously glandular hairs mixed with short glandular and/or eglandular hairs, or more or less glabrous except for a few long eglandular or very short glandular hairs ..... 6
- 6a. Involucre with very short, usually dense, sometimes glandular hairs mixed with longer and more conspicuously glandular hairs on outer surface. Involucre often on short, (0) 1-3 (-4) mm long peduncles, arranged in long, lax panicles, not clustered in the axils. (north eastern NSW and south eastern Qld) ..... a. var. *floribunda*
- 6b. Involucre without short glandular hairs, very rarely with long and conspicuously glandular hairs, more commonly glabrous all over or with a few eglandular hairs at the join of the outer bracts or on the margins, rarely these all over the outer surface. Involucre more or less sessile, clustered in the axils, with each cluster c. 1 cm in length and consisting of up to 10-14 involucre (northern NSW and Brisbane area) or, in specimens from the Cairns area, the axillary clusters of involucre smaller and terminated by an elongated spike (coastal south eastern Qld and northern NSW, Cairns area) ..... b. var. *pubescens*
- 7a. Capsules completely glabrous, rarely with a few sparse eglandular hairs at very apex ..... 8
- 7b. Capsules with moderately dense eglandular hairs sometimes mixed with glandular hairs ..... 11
- 8a. Involucre densely clustered in axils. Capsules dark brown, well exerted from involucre. [Leaves and stems with short, dense, upright eglandular hairs]. (Cape York Peninsula and Papua) ..... d. var. *canescens*
- 8b. Involucre in long panicles or spikes. Capsules light to mid brown, included in or shortly exerted from involucre ..... 9
- 9a. Leaves and stems completely glabrous (WA) ..... 10
- 9b. Leaves and stems pubescent (north Qld) ..... var. *floribunda* (Note 2a)
- 10a. Rachis, outer surface of involucre and their subtending bract pairs completely glabrous. Calyx with lax eglandular hairs on outer surface, sometimes mixed with short glandular hairs. Corolla white or pale cream suffused with purple (Kimberleys in WA, NT) ..... j. var. *distans*
- 10b. Rachis, outer surface of involucre and their subtending bract pairs with short, moderately dense, glandular hairs and long, conspicuously glandular hairs. Calyx with short glandular hairs but lacking eglandular hairs. Corolla purple, pink or violet. (Kimberleys in WA and Victoria River area of NT) ..... i. var. *angustifolia*
- 11a. Capsules with conspicuously glandular hairs (these sometimes difficult to see in collections from Cape York Peninsula) mixed with eglandular hairs ..... 12
- 11b. Capsules only with eglandular hairs ..... 13



- 12a. Rachis, and involucre subtending bract pairs without conspicuously glandular hairs; involucre occasionally with long, sparse conspicuously glandular hairs on outer surface mixed with usual indumentum of short, dense glandular hairs and longer, sparser, down-turned eglandular hairs (Cape York Peninsula) ..... f. var. *yorkensis*
- 12b. Rachis, outer surface of involucre and their subtending bract pairs with dense, long, conspicuously glandular hairs mixed with short glandular hairs (WA) ..... aff. var. *suaveolens* (q.v., Note 2)
- 13a. Leaves linear-lanceolate, always with rusty or greyish velvety tomentum, with persistent short glandular hairs. Capsules mid to dark brown, with a few eglandular hairs confined to apex (Riversleigh and Wollgorang area of NT/Qld border) ..... g. var. *cinerea*
- 13b. Leaves ovate, usually dark green, rarely with rusty tomentum and rarely in young parts with short glandular hairs, but these not persisting with age. Capsules light brown, with eglandular hairs covering the expanded seed-bearing portion (Arnhem Land and adjacent islands of NT, Broome area in WA) ..... h. var. *varia*

#### a. var. *floribunda*

*Hypoestes floribunda* R.Br. "2. *paniculata*" Benth., Fl. Austral. 4 (1868) 554 p.p. (as to Brown collections from Shoalwater Bay). — *Hypoestes paniculata* (Benth.) F.M. Bailey, Compr. Cat. Qld Pl. (1913) 374, nom. illeg.: (see Typification).

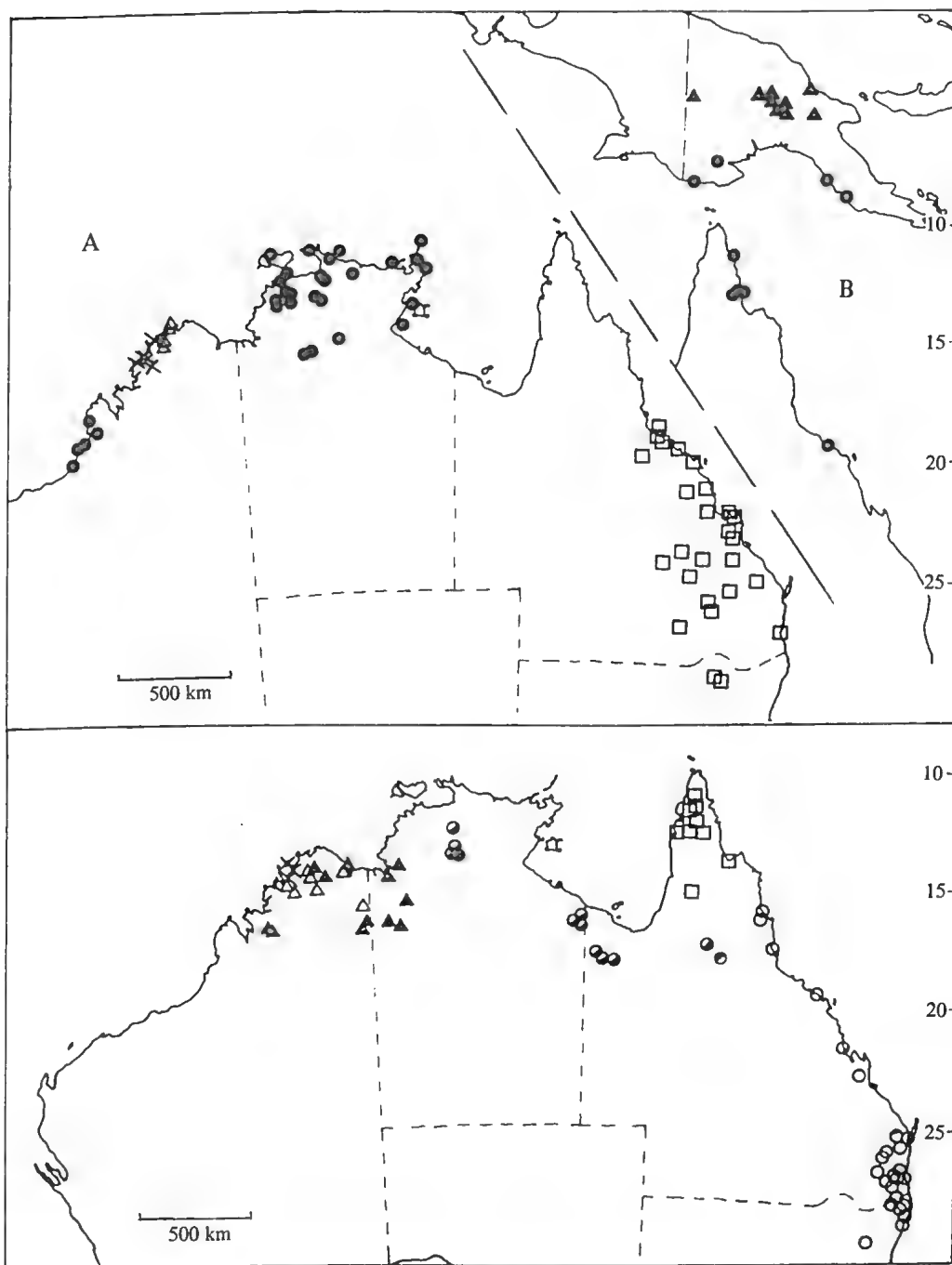
*Hypoestes floribunda* R. Br. 'form 1', Jacobs & Pickard, Pl. N.S. Wales (1981) 61, (p.p. as to plants from the Western Slopes region of New South Wales and from Queensland).

*Hypoestes floribunda* R. Br. '1. *densiflora*' auct. non Benth.: Benth., Fl. Austral. 4 (1868) 554 p.p. (as to syntypes listed on p. 200).

Erect perennial herb or shrubs to 50 cm high. *Branches* with sparse to dense, upright or downturned eglandular hairs in all parts, rarely more or less glabrous. *Leaves* ovate, 1-9 x 0.4-2.5 cm, more or less entire or somewhat crenulate, often dark brownish-green above, paler below (from dried specimens) with very sparse to moderately dense cover of eglandular hairs on both surfaces, more dense on midribs, lateral veins and margins, very dense on young leaves, rarely more or less glabrous, sometimes gland-dotted on lower surface. *Inflorescence* a terminal panicle with 2, rarely 4, involucre at each node, sometimes appearing 1 or 3 because of unequal development. *Rachis* in lower parts with long eglandular hairs, towards apex mixed with short dense glandular hairs, sometimes (especially in brigalow-associated collections) with longer, conspicuously glandular hairs as well, rarely more or less glabrous; *involucre subtending bract pairs* leaf-like, with long, appressed eglandular hairs on both surfaces, sometimes long, conspicuously glandular hairs in younger parts, lower down petiolate and ovate, sometimes unequal in size, sometimes exceeding involucre, or higher up smaller and with short, very broad, petioles. *Involucres* (3-) 5-9 mm long on (0-) 1-3 (-4) mm long peduncles, on outer surface with indumentum of short ? glandular hairs usually mixed with relatively dense, longer, downturned eglandular hairs, sometimes longer conspicuously glandular hairs; outer bracts joined for (1/3-) ½ of length; inner bracts slightly shorter than outer. *Calyx* segments usually shorter than involucre, rarely exceeding it (*Johnson 2148*) possibly by elongation after anthesis, externally with short, dense, ?glandular hairs on outer surface of segments, mixed with long, eglandular hairs, particularly on margins, glabrous below. *Corolla* blue-purple, purple, pink, whitish lined with purple, or mauve with lighter throat; tube 5-6.5 mm long; upper lip 8.5-14 mm long. *Stamens*: filaments pubescent at least in basal half. *Capsule* narrow-oblong, 10-12.5 mm long, well exerted from involucre to 4-8 mm, dark brown, completely glabrous or with few very sparse eglandular hairs near apex. Fig. 36B, D.

#### *Distribution*

*H. floribunda* var. *floribunda* is found mostly in south-eastern Queensland with a few collections, mainly from Warialda, in north-eastern New South Wales (Fig. 37).



Figs. 37-38. Distribution of *Hypoestes sparsiflora* and the varieties of *Hypoestes floribunda*. Fig. 37A. □ *var. floribunda*; ● *var. varia*; △ *var. sauveolens*; × *H. sparsiflora*. Fig. 37B. *H. floribunda* *var. canescens*; ▲ *var. neoguineensis*. Fig. 38. *H. floribunda* ○ *var. pubescens*; □ *var. yorkensis*; ● *var. cinerea*; ● *aff. var. cinerea*; ▲ *var. angustifolia*; aff. △ *var. angustifolia* × *var. distans*.

### Ecology

Var. *floribunda* has been found in brigalow (*Acacia harpophylla*) or belah (*Casuarina cristata*) forest in or near creeks, in vine-scrub or vine-thicket in closed forest on a frontal dune and in cleared areas amongst shrubs and small trees.

### Notes

#### 1. Variation within var. *floribunda*

a. The specimens associated with brigalow (e.g. *Johnson* 778, 2148; *Speck* 1839) are often extremely dark in the dried state; other material remains green after drying. The conspicuously glandular hairs on the involucre in the brigalow collections also extend onto the subtending bract pairs and rachis in the younger parts of the inflorescence, whereas in other collections they are usually confined to the involucre and peduncle only (but see Note 2a).

b. *McLaughlin* G44 from Springsure in Queensland is much less robust than collections of the rest of the taxon. Involucres are 4-5 mm long, with the outer bracts only joined for 1/3 of their length, capsules are hardly exerted, and the calyx exceeds the involucre in fruit. The collector's notations refer to its small habit and this may indicate that the plant was in a depauperate condition.

c. *McDonald* 1367 from Abbot Bay in Queensland differs from other material of var. *floribunda* in the eglandular hairs on all parts being very short and downturned, the almost complete lack of conspicuously glandular hairs on the involucre and the very dense, long, matted eglandular hairs on the calyx. Its affinities seem to be with var. *floribunda* as it is similar to *McDonald* 1401 from the same area, differing from it only by the lack of glandular hairs and the hairiness of the calyx. Further collections from the region are required to establish the status of the specimen.

d. A group of collections from Queensland (*Dietrich* 849, *Thozet* 466, *O'Shanesy* 80 and to some extent, the type collection *Brown* 2949) all differ from the other collections of var. *floribunda* by possessing smaller involucre (3-6 mm long) arranged in a less crowded fashion, more or less glabrous branches, leaves and rachises and more highly branched inflorescences. This is particularly evident on *Thozet* MEL 601951 where a specimen of the more usual var. *floribunda* is mounted with a specimen exhibiting the characteristics just discussed.

#### 2. Specimens intermediate between var. *floribunda* and other varieties

##### a. *H. floribunda* var. *floribunda* — var. *canescens*

These two varieties should be distinguishable by the number of involucre at each node, two in the case of var. *floribunda* and one in the case of var. *canescens*. *Laver* BRIU 56302a from the eastern Queensland coast, seems to be intermediate in this usually reliable diagnostic character, since some involucre subtending bract pairs (mostly those about mature involucre) have only one involucre, while in younger parts they often subtend two involucre. The one capsule present in the Laver collection is predominantly glabrous with just a few, very sparse, eglandular hairs at the apex. *Michael* 1602 from Magnetic Island off the Queensland coast and *Cunningham* 65 from South Goulbourn Island in Northern Territory also belong here. The large disjunction of the Cunningham collection indicates a possibly erroneous locality, but some of the Northern Territory coastal collections (treated here under var. *varia*) do show a close approach to var. *canescens* in habit. None of the three collections cited have involucre as densely arranged as they are in var. *canescens*.

b. *H. floribunda* var. *floribunda* — var. *velutina*

*H. floribunda* var. *velutina* from the Mt Garnett area of Queensland is characterised by its pubescent capsules and the presence of dense glandular hairs on the young leaves; on the involucre these glandular hairs are mixed with occasional, more conspicuously glandular hairs of a similar length. Specimens listed after this variety approach var. *velutina* by the presence of a few hairs at the apex of the capsules and by the similar ?glandular hairs on the lower surface of the young leaves. They differ from var. *velutina*, by the lack of woolly eglandular hairs on the leaves, being instead densely covered by short, upright, inconspicuously glandular hairs.

c. *H. floribunda* var. *floribunda* — var. *pubescens*

Specimens from the Atherton area (*Betche s.n.*, *Bick 99 & 101*, *Bowman s.n.*, and *Pentake s.n.*) resemble var. *pubescens* in their lack of any very short, dense, inconspicuously glandular hairs on the involucre, but approach var. *floribunda* in their elongate inflorescences in which each node clearly possesses two involucre.

*Pentake* MEL 100837 is somewhat unusual in possessing short, upright, eglandular hairs on all parts of the inflorescence, stem, petioles and at least the midrib and veins of the leaves. The lack of any very short, dense, ?glandular hairs, places it in var. *pubescens* although in habit, except for the slightly longer (4-5 mm) peduncles, it probably more resembles var. *floribunda*. The only other collection with short eglandular hairs over the involucre is *McDonald 1367* (Note 1c.), but the hairs are appressed and the calyces are covered by an extremely dense mat of eglandular hairs absent from the *Pentake* specimen.

*Specimens examined*var. *floribunda*

NEW SOUTH WALES: *Hadley s.n.*, v.1907, Warialda (NSW 151890); *Rupp s.n.*, ix.1906, Old Gunyerwarildi, Warialda (MEL 100810); *Woollett s.n.*, viii/ix.1929 Warialda (NSW 151891).

QUEENSLAND: *Anon. 296*, s. dat. (MEL 601953); *Blake 5842*, 9.v.1934, Palardo (BRI); *Bowman 149*, ?1862, (MEL 100795); *Brown s.n.*, 1802-5 (BRI 141421, K, MEL 566474, G-DC microfiche AD); *Brown 2949*, s. dat., E. Coast and Shoalwater Bay (K); *Brown 2949*, 3.ix.1802, Conical Pine Hill, Shoalwater Bay (BM — 3 sheets: lecto- and isolectotypes); *Dockrill 402*, 17.v.1972, Barrabas Scrub (BRI, QRS); ? *Domin s.n.*, s. dat. (MEL 100795); *Dietrich 849*, 1863-5, Brisbane River (AD, CANB, NSW); *Dietrich 849*, 1866, Rockhampton (MEL: 2 sheets, NSW); *Fitzalan s.n.*, s. dat., Mt Elliot (MEL 100834); *Fitzalan s.n.*, i.1871, Mt Dryander (MEL 100833); *Foot s.n.*, 1891, Lake Salvador (= ? Salvator) (MEL 100768); *Johnson 778*, 28.iv.1959, Gettesvale, c. 40 miles NE of Wandoan (BRI, CANB, K); *Johnson 2148*, 16.iv.1961, Arcadia, 45 miles N of Injune (BRI); *Jones 2404*, 3.vii.1963, Stockyard Ck, near Sarina (CANB); *Jones 3845*, 15.viii.1968, Yatton Ck, N of Broadsound Range (CANB); *McDonald 180*, 22.ix.1971, Dipperu Nat. Park, c. 20 km S of Nebo (BRI); *McDonald 1401 & Batianoff*, 9.iv.1975, 6 km N of Elliot R., Abbot Bay (67 km SE of Home Hill) (BRI); *McDonald 3281*, 18.iv.1980, Goodnight Scrub, 30 km S of Gin Gin (BRIU); *McLaughlin G44*, 15.iv.?, "Buckleton", near Springsure (BRI); *Manchie s.n.*, 17.iii.1955, "Yamburgan", Noo(n)do (BRI); *Michael s.n.*, s. dat., Magnetic Island (BRI); *O'Shanesy ? 31 s.n.*, 10.iii.1868, Gracemere (MEL 100843); *O'Shanesy 80*, 1.v.1867, Near Table Mt (MEL); *O'Shanesy 4015*, s. dat., between Cornet & Nofoa Rivers (MEL 100838); *L.S. Smith T 47*, 3.iii.1942, Mt Stuart, c. 6 m S of Townsville (BRI); *Speck 1839*, 14.x.1963, on Bedourie Rd, 5.7 m N of Fairfield Homestead (BRI, CANB, K, NSW); *Speck 1977*, 28.iv.1964, 18 m SW of Wandoan (NSW, K); *Story & Yapp 94*, 28.vi.1962, 38 m W of Nebo Township (BRI, CANB, MEL, NSW, NT); *Thozet 466*, s. dat., Crocodile Ck (MEL 100792); ?*Thozet 466*, s. dat., Rockhampton (MEL 601951, MEL 601952); *White 10817*, iv.1937, Mt Murchison, Callide Valley (BRI).

var. *floribunda* — *canescens* intergrade

QUEENSLAND: *Laver s.n.*, 4.v.1975, near lighthouse, Cape Cleveland (BRIU S6302a); *Michael 1602*, Magnetic Island (BRI).

NORTHERN TERRITORY: *Cunningham 65*, 1819, South Goulbourn Island (BRI, MEL, NSW).

var. *floribunda* — var. *velutina* intergrade

QUEENSLAND: *Anon. (Dallachy) s.n.*, s. dat. (Kp.p.); ?*Dallachy s.n.*, c. 1865-6, Edgecombe Bay (MEL 601946); *Dietrich 2782*, s. dat., Port Jackson (? locality incorrect) (MEL); *Dietrich 2802*, s. dat., Port Denison (CANB, MEL);

*Fitzalan s.n.*, s. dat., Port Denison (MEL 100823, MEL 100825, MEL 601949, MEL 601956, K.p.p.); *Fitzett s.n.*, s. dat., Port Denison (MEL 601955); *Thozet s.n.*, s. dat., Rockhampton (MEL 601951 p.p.).

var. *floribunda* — var. *pubescens* intergrade

QUEENSLAND: *Betche s.n.*, viii.1901, Atherton (MEL 100789, NSW 151879); *Bick 99*, s. dat., Atherton (BRI 141415); *Bick 101*, vi.1913, Atherton (BRI 141413); *Bowman s.n.*, 1870, Herberts Ck (MEL 100804, MEL 100820); *Cassels s.n.*, 5.v.1968, Tinaroo Creek area (QRS 020912 and QRS 020913); *Fitzalan s.n.*, 1877, Cairns (MEL 100802); *Pentake s.n.*, 1888, Mt Armit (MEL 100837).

aff. var. *floribunda*

QUEENSLAND: *McDonald 1367 & Batianoff*, 8.iv.1975, 2 km N of Elliot River, Abbot Bay (BRI).

b. var. *pubescens* Benth., Fl. Austral. 4 (1868) 554, p.p. (excluding Kinley and Leichhardt collections); F.M. Bailey, Qld Fl. 4 (1901) 1148; F.M. Bailey, Compr. Cat. Qld Pl. (1913) 374.

*Lectotype here designated: Beckler s.n.*, s. dat., Clarence River (K); *isolectotypes*: (MEL 601960, MEL 100796); *possible ? syntype and isolectotype: Anon. (? Beckler) s.n.*, s. dat. Clarence River (NSW 151882); *other syntype: Bidwill s.n.*, s. dat., Wide Bay (K): See Typification.

*Hypoestes densiflora* (Benth.) F.M. Bailey, Compr. Cat. Qld Pl. (1913) 374 — *H. floribunda* R. Br. "1. *densiflora*" Benth., Fl. Austral. 4 (1868) 554 p.p. (as to specimens with involucre in axillary clusters). *Types*: see p. 200.

*Hypoestes australiensis* Lindau, Feddes Repert. 11 (1913) 123.

*Syntypes: Beckler*, x.1859 -iv.1860, Hastings and Richmond Rivers, New South Wales (M: 4 sheets); *possible isotypes: Anon. (?Beckler) s.n.*, s. dat. Clarence River (NSW 151882); *Beckler s.n.*, s. dat., Clarence River (MEL 601960, MEL 100796, K). See Typification.

*Hypoestes floribunda* R. Br. form 2, Jacobs & Pickard, PL.N.S. Wales (1981)61.

Undershrub to 1 m high. *Branches* more or less 4-angled with two of the faces longitudinally grooved, with sparse to dense, erect and often down-turned apically, stout, 0.25-0.5 mm long eglandular hairs, sometimes in 2 longitudinal rows on angles, glabrous between, rarely more or less glabrous with only few hairs at nodes. *Leaves* shortly petiolate, blade ovate, 1-12 x 0.5-4.5 cm, eglandular hairs similar to those on stems, dense on younger leaves, petioles, midribs, lateral veins and margins of older leaves, other parts glabrous or only sparsely hairy. *Inflorescence* axillary thyse, more or less sessile or on short peduncle to 5 mm long, composed of 1-4 nodal clusters to 1 cm long, each cluster of up to 10-14 involucre, sometimes (in N. Qld) in lower parts of plant cluster elongating into spike with 2 involucre at each node; nodal clusters not overlapping, composed of 2 opposite, subsessile groups of involucre, each subtended by small leafy bract, each group consisting of 1-4 pairs of subsessile, overlapping involucre, each involucre subtended by small bract; *rachis* glabrous or with sparse downturned eglandular hairs similar to those on stems; *involucre subtending bracts* leaf-like in lower parts of plant, elsewhere narrowly to broadly triangular, 1-2 mm long above, with sparse eglandular hairs similar to those on stems. *Involucre* subsessile, 5-8-(9.5) mm long, outer surface usually glabrous, shiny in most parts, scattered eglandular hairs similar to those on stem confined to midrib and margins or more rarely, more widespread, rarely mixed with a few long, conspicuously glandular hairs, or glandular hairs, very rarely, throughout (*Simmonds BRI 114471*) or rarely (*Jones 2955*) with some short, obscurely glandular hairs at junction of outer bracts; outer bracts joined for 1/3-1/2 of length; inner bracts shorter than outer. *Calyx* much shorter than bracteoles; lobes ciliate with long eglandular hairs, sometimes eglandular hairy on rest of surface. *Corolla* purplish pink to deep rose; tube 6-8 mm long; upper lip

12-14 mm long. *Stamens*: filaments sparsely pubescent. *Capsule* 9-12 mm long, well exserted (to 5 mm) from involucre, dark brown in upper seed-bearing portion, glabrous or very rarely with few sparse eglandular hairs near apex.

### Typification

#### 1. *H. floribunda* R. Br. var. *pubescens* Benth.

Bentham (1868) cited four collections under his var. *pubescens*, those of Bidwill and Leichhardt from Queensland, Kinley from Arnhem Land and Beckler from New South Wales. All four collections comply with his statement "rather densely clothed with a scabrous or soft pubescence", but they belong to three different varieties as recognised here. The Bidwill and Beckler collections belong to the same variety, while the Leichhardt collection belongs with var. *velutina* and the Kinley collections with var. *varia*. The lectotype has been chosen from the variety most represented in the material. The Beckler collection in K is chosen as lectotype as it fits the protologue, has flowers and mature capsules, is represented by two isotypes in MEL and a possible isotype in NSW. The Bidwill collection, like the Leichhardt and Kinley specimens, has no duplicates and it also lacks capsules.

#### 2. *Hypoestes australiensis* Lindau

A lectotype has not been chosen for this species because I have not yet ascertained whether there is still extant material in Berlin. The species is however, represented by 4 sheets in M which originated from Beckler's 1859-60 expedition. The Beckler material was apparently despatched to Munich in 1884 and from it Professor Ross was able to grow specimens (presumably from seed), some of which were then sent to Lindau. The sheets in Australian herbaria are possibly duplicates of the original Beckler collection although they are annotated as coming from Clarence River rather than Hastings and Richmond Rivers as occurs on the Munich sheets and in the protologue. However, Clarence River of the time of Beckler's journey was a squatting district of New South Wales which included the Hastings and Richmond Rivers (Wells 1848) and Mueller, whose blue labels are attached to the Australian specimens, frequently used general areas on labels when more specific localities were available (e.g. Rockingham Bay for Dallachy's collections from Proserpine Creek or Mt Mueller, Blake 1955). In addition one of the Munich sheets bears a handwritten 'Clarence River' annotation.

In the absence of Berlin material the sheet in M which bears a copy of Lindau's letter and is labelled as "Original expl." would be the best material for selection as lectotype.

### Distribution

*Hypoestes floribunda* var. *pubescens* is known from the Brisbane, south-eastern Queensland and New England region of New South Wales. Allied material also comes from the Cairns area of North Queensland (Fig. 38).

### Ecology

From the sparse information on labels, it seems to be mostly found as a component of the undergrowth in rainforest. In Queensland, the majority of collections were made last century both from the Brisbane and the Cairns area, but there are a few recent collections from New South Wales. Flowering specimens have been collected between March and June.

### Notes

1. Var. *pubescens* is distinguished from the other varieties by the combination of its paired involucre per node (although this characteristic is somewhat obscured by the clustered nature of the inflorescence), its glabrous capsules and its predominantly glabrous involucral bracts. It is most closely related to var. *floribunda* with which it intergrades (p. 206), but the two can

usually be distinguished from each other by their inflorescence arrangement and involucre bract indumentum.

2. Material from the widely disjunct Cairns area has been placed within var. *pubescens* because it agrees closely with that variety. It is discordant only by the spikes which arise from the clustered involucre, a characteristic which indicates some approach to var. *floribunda*, also occurring in the same area.

### *Specimens examined*

NEW SOUTH WALES: *Anon.* (?Beckler) *s.n.*, s. dat. Clarence River (NSW 151882); *Beckler s.n.*, s. dat. Clarence River (K: lectotype, MEL 601960, MEL 100796); *Boorman s.n.*, x.1909, Upper Copmanhurst (NSW 151881); *Constable s.n.*, 8.i.1953, Mt Glennie Slopes, MacPherson Range (NSW 22177, K); *Dodkin H 223*, 7.xii.1976, Baxter's Creek, Nowendoc (NSW); *Floyd 892*, 14.iv.1978, Cherry Tree Forest Reserve (NSW); *Law s.n.*, s. dat. New England (MEL 100830); *McAuliffe s.n.*, iii.1911, Lismore (NSW 151880); *Rupp 19*, v.1909, Copmanhurst (NSW); *Rupp s.n.*, viii.1911, Copmanhurst (MEL 100809); *Stackhouse s.n.*, 1882, Richmond River (MEL 100799); *Town Clerk s.n.*, 1.iii.1935, Kyogle (NSW 151897).

QUEENSLAND: *Anon.* [Bowman] *s.n.*, s. dat., Nerkool Ck (MEL 601954); *Anon.* [Cunningham] *19*, 1929, Brisbane River (K); *Anon.* (?Dallachy) *s.n.*, 21.v.1866, Rockingham Bay (MEL 601945); *Anon. s.n.*, s. dat. (NSW 151901); *Bailey s.n.*, s. dat., 3 m Scrub (BRI); *Bailey s.n.*, s. dat., Ennoger Ck or Dam (BRI 141441, BRI 141442); *Bidwill s.n.*, s. dat., Wide Bay (K); *Blake & Everist s.n.*, 26.iii.1932, between Indooroopilly and Lone Pine (BRI 1214865); *A. Cunningham 104*, viii.1828, Brisbane River (K); *Dallachy s.n.*, s. dat., Rockingham Bay (MEL 601950); *Eaves s.n.*, 1874, (MEL 100824); *Eaves s.n.*, s. dat., Wide Bay (MEL); *Eaves s.n.*, s. dat. Mary River (MEL 100836); *Eaves s.n.*, 1872, Moreton Bay (MEL 100835); *Eaves s.n.*, s. dat. Broadwater (MEL 100822 p.p.); *Gilbert s.n.*, iii.1976, near Toowoomba (BRI 207893); *Hartmann 16*, 18.iv. Toowoomba (MEL); *Jones 2955*, 17.iii.1965, Coomera River (BRI); *Law s.n.*, s. dat. Western Downs (MEL 100817); *Longman s.n.*, 1931, Table Top, Toowoomba (K); *Mueller 25*, vii.1855, Brisbane River, Moreton Bay (MEL 601948); *O'Shanesy 212*, 29.vi.1865, Salt Water Ck and 16, 17.x.1866, River Stone (MEL 601947); *Shirley s.n.*, s. dat. Mt French (BRI 141444); *Simmonds s.n.*, vi.1887, Mt Mistake (BRI 114471); *Simmonds s.n.*, 14.vi.1888, Peecheys, off Waterworks Rd beyond Ashgrove, Brisbane (BRI 141970); *Smith s.n.*, 18.iv.1957, Yarraman (BRI 017458); *Statter 119*, 1882, S. Pine (MEL); *Statter s.n.*, s. dat. Pine River (BRI 141437); *Stuart 75*, s. dat. Moreton Bay (MEL 100797); *Swain s.n.*, iii.1917, Chinatown, Gympie Forest District (BRI 141484); *White s.n.*, v.1913, Rosewood (BRI 141443); *White 9942*, 31.iii.1934, Mt Edwards (BRI).

c. var. *velutina* R.M. Barker, var. nov.

*Holotype*: *Hyland 9829*, 30.v.1979, Bucks Gully Scrub, deciduous vine thicket (QRS).

*Hypoestes floribunda* R. Br. var. *pubescens* auct. non Benth.: Benth., Fl. Austral. 4 (1868) 554 p.p. (as to Leichhardt collection).

Varietas nova *H. floribundae* a var. *floribunda* et var. *pubescenti* differt capsulis pubescentibus et foliis juvenis dense glanduliferis pilis in paginis ambibus et a varietatibus omnibus ceteris involucri duobus ad nodum omnem.

Erect sub-shrub to 1 m high. *Branches* obscurely 4-6-angled, sometimes longitudinally grooved on two opposite faces, with dense mat of usually short, sometimes (*Bancroft 268*, *Smith 2885*) longer and woollier, intertwined eglandular hairs. *Leaves* shortly petiolate, blade ovate, 0.7-5.5 x 0.3-2.5 cm, on both surfaces when young (particularly on involucre subtending bracts which intergrade with leaves) with short, dense, erect, inconspicuously glandular hairs, mixed with longer, sparser, often appressed eglandular hairs, indumentum densest on petioles, midribs and main lateral veins, only the eglandular hairs persisting with age. *Inflorescence* of involucre arranged in terminal, spike-like, leafy panicles with 2-4 involucre at each node, involucre at consecutive nodes overlapping or distant; *rachis* with similar indumentum to branches except for the addition of dense, erect, short, inconspicuously glandular hairs (similar to those on young leaves and leaf-subtending bracts) in apical parts of the inflorescence; *involucre subtending bracts* leaf-like, of similar size to involucre and with similar indumentum to leaves and young rachis. *Involucre* sessile, (5-) 8-10.5 mm long, on outer surface with dense, short, inconspicuously glandular hairs (as on young leaves, involucre subtending bracts

and rachis) mixed with sparser, conspicuously glandular hairs of similar or slightly longer length, together with slightly longer eglandular hairs which are densest on the midrib of the outer bracts; outer bracts fused for  $\frac{1}{2}$  or more of their length; inner bracts shorter than outer, similar indumentum except for sometimes lacking longer conspicuously glandular and eglandular hairs. *Calyx* segments shorter than inner bracts, with short, dense, erect, inconspicuously glandular hairs on outer surface. *Corolla* mauve or reddish-mauve; tube 7-10 mm long; upper lip 7-13 mm long. *Stamens*: filaments sparsely pubescent. *Capsule* shorter than involucre or shortly exserted, c. 9 mm long, mid to dark brown in upper half, with eglandular hairs on expanded seed-bearing portion.

### Distribution

*H. floribunda* var. *velutina* is found only in the Mt Garnett area of North Queensland.

### Ecology

It is recorded from deciduous vine thicket on red basaltic soil or basaltic krasnozem. Flowering specimens have been collected from May to August.

### Notes

1. This variety is distinguished by its paired involucre at each node, its pubescent capsules and the dense inconspicuously glandular pubescence of the younger leaves and involucre subtending bracts which have a velvety appearance. The epithet is based on this last characteristic.

2. For specimens intergrading between var. *velutina* and var. *floribunda* see the latter treatment.

### Specimens examined

QUEENSLAND: *Armit* 438, s. dat., Ennasleigh River (MEL 100842); *Bancroft* 268, xi.1908, Stannary Hills (BRI); *Clarkson* 2524 and *Byrnes*, 10.viii.1979, 40 Mile Scrub, c. 5 km N of the junction of the Kennedy Development Rd and the Gulf Development Rd (BRI); *Hyland* 9829, 30.v.1979, Bucks Gully Scrub (QRS); *Jacks* s.n., 4.1977, 40 mile scrub SW of Mt Garnett (BRIU); *Leichhardt* s.n., s. dat., The Burdekin (MEL 601961); *Smith* 3885, 24.viii.1948, Lynd Scrub, c. 64 km SW to SSW of Mt Garnett (BRI); *Webb and Tracey* 7304, 1962, Lynd Scrub, W of Mt Garnett (BRI).

d. var. *canescens* Benth., Fl. Austral. 4 (1868) 554.

*Lectotype* here designated: *Daemel* s.n., s. dat. Cape York (K p.p.); *isosyntypes*: (BM, MEL 601943, MEL 601944).

*H. floribunda* R. Br. "2. *paniculata*" auct. non Benth.: Benth., Fl. Austral. 4 (1868) 554 p.p. (with respect to Bynoe collection).

Erect shrub, 1-2 m high. *Branches* obscurely 4-6-angled, with dense, very short, down-turned eglandular hairs. *Leaves* with petioles to 2.5 cm long, blade ovate, 1-13.5 x 0.8-7 cm, young parts with very dense velvety cover of short, appressed, eglandular hairs, similar to those on branches and most dense on petioles, midrib and main lateral veins, sparser or absent with age. *Inflorescence* a shortly pedunculate axillary cluster of involucre, each cluster consisting of highly condensed panicles of c. 2-8 mature involucre, a single involucre at each node, *rachis* with similar eglandular indumentum to stem and leaves; *involucre subtending bracts* broadly triangular, 0.5-1.5 mm long, similar indumentum to rachis. *Involucre* 7.5-9 mm long, subsessile, white about margins, outer surface with indumentum similar to that on rachis and



subtending bracts mixed with tiny inconspicuously glandular hairs, or (in *Stocker 1050* and New Guinea collections) with much longer, conspicuously glandular hairs; inner bracts shorter than involucre. *Calyx* segments shorter than inner bracts, outer surface with inconspicuously glandular hairs. *Corolla* purple; tube 6.5-11 mm long; upper lip 12-15.5 mm long. *Stamens* with hairy filaments. *Capsules* usually exerted from involucre, 9-10 mm long, dark brown apically, glabrous or very rarely (*Young ?30 BRI 141422*) with very sparse eglandular hairs at apex.

### Distribution

*H. floribunda* var. *canescens* is known from north Queensland (Fig. 37) from Cape Upstart and the McIlwraith Range or further north from Temple Bay and from Papua.

### Ecology

Records from Queensland indicate a rainforest habitat or its margins for this variety. In New Guinea it has been recorded from a roadside in dry rainforest or near mangroves. Flowering specimens have been collected between July and October.

### Notes

1. This variety is defined on the basis of a single involucre per node, clustered inflorescences and indumentum type, but there is variation amongst the collections in other characters. The collection by Stocker (*Stocker 1050*) and the New Guinea collections have conspicuous glandular hairs on the involucre and inner bracts; these are lacking in the other Australian collections. *Young ?30* has a few eglandular hairs on its capsules while those of all the other collections are glabrous. In the New Guinea material the involucre are less densely clustered than in the Queensland specimens.

2. This variety appears to form an intergrade (as might be expected) between the polymorphic var. *varia* of the Northern Territory and the other Queensland taxa of var. *floribunda* and var. *pubescens*, usually resembling the latter varieties more closely in habit, leaves and capsules, and differing from them only in the possession of a single involucre at each node. The only difference between this variety and the "beach" collections of var. *varia* appears to be the presence of eglandular hairs on the capsules of var. *varia* and their absence in var. *canescens*. More field observations and collections would enable a review of the infraspecific taxonomy and this group. For collections intermediate between var. *canescens* and var. *floribunda* see p. 206.

### Specimens examined

QUEENSLAND: *Butler 528*, 31.vii.1978, McIlwraith Range; upper reaches of Chester River, toward Double Hill (CBG); *Bynoe s.n.*, s. dat., Cape Upstart (K p.p.); *Clarkson 2440*, 30.vii.1978, Upper reaches of Chester River on E fall of McIlwraith Range (BRI); *Daemel s.n.*, s. dat., Cape York (K p.p., BM, MEL 601943, MEL 601944); *Stocker 1050*, 7.ix.1973, Rocky River (QRS); *Young ?30*, vii.1923, Temple Bay (BRI 141422, BM).

PAPUA NEW GUINEA: *Brass 9030*, x.1936, Lower Fly R, E bank opposite Sturt Island (LAE); *Darbyshire 838*, 20.viii.1962, c. 2 m N of Ikikina village, Kairuku Sub-district (LAE); *Heyligers 1166*, 10.v.1965, Tovobada Hills, 12 m N of Pt Moresby (LAE, K); *Pullen 7068*, 14.viii.1967, c. 1 mile inland, E of Bula at Morehead R estuary (LAE).

e. var. *neoguineensis* R.M. Barker, var. nov.

Varietas nova *H. floribundae*, a varietatibus omnibus ceteris differt floribus parvioribus, filamentis glabris et corolla externa pilis glandulis carenti.

*Holotype*: *Flenley ANU 2073*, 27.vii.1964, Lufamunda, 1 mile N of Wabag airstrip, W Highlands (LAE); *isotypes* n.v.: (CANB, L, K, A).

Erect sub-shrub, to 2 m high. *Branches* 4-6-angled, often grooved longitudinally on 2 or 4 faces, in young parts usually with rows of very short, downturned eglandular hairs particularly along sides of grooves or on angles, rest glabrous or more sparsely pubescent, glabrescent. *Leaves* petiolate, largest leaves with petioles to 5 cm long, blade 1.5-15 x 0.5-6 cm, similar eglandular hairs to those on branches, dense on petiole, midrib and veins, sparse elsewhere. *Inflorescence* a short spike of to 8 involucre arising in each of upper axils, spike often dichotomously branched, usually 1-sided, with single involucre at each node, involucre just overlapping each other; *rachis* with short, more or less appressed eglandular hairs; *involucre subtending bracts* narrowly triangular, somewhat unequal, 2-5 mm long. *Involucre* sessile, 8-10.5 mm long, indumentum on outer surface and apex of inner bracts consisting of very short eglandular, more or less appressed hairs, sometimes mixed with occasional glandular hairs, internally glabrous, outer bracts joined for 1/3 length; *inner bracts* of similar length to outer. *Calyx* segments shorter than inner bracts, similar eglandular pubescence to involucre. *Corolla* white or pale purple, deeper purple marking in throat, externally lacking glandular hairs but with fine, weak, eglandular hairs; tube 3-7 mm long, lobes 5-8 mm long. *Stamens* glabrous filaments. *Capsule* c. 8-9 mm long, apically acute, with eglandular hairs all over upper, expanded seed-bearing portion.

### Distribution

*H. floribunda* var. *neoguineensis* is known only from northern New Guinea. Fig. 37.

### Ecology

As with a number of the varieties of *H. floribunda*, this appears to be a pioneer plant growing in garden fallow or regrowth areas, often along tracks. Flowering specimens have most commonly been collected between July and October.

### Note

This variety should be easily distinguished from the other varieties of *H. floribunda* by its smaller flowers, glabrous filaments and lack of any glandular hairs on the external surface of the corolla.

### Specimens examined

PAPUA NEW GUINEA: *Anon. HVN 68*, s. dat. 40 km NE Ningerum, Kuinga sub-district (LAE); *Borgmann 339*, 28.x.1960, Towomambino (LAE); *Brass 32402*, 3.xi.1959, Kassam (LAE); *Conn & Akakauaro 406*, 24.vii.1977, Above Aiyura (K); *Flenley ANU 2073*, 27.vii.1964, Lufamunda, 1 mile N of Wabag airstrip (LAE: holotype); *Henty & Sayers NGF 20578*, 4.viii.1964, Boringe, Madang District (LAE); *Hoogland & Pullen 5916*, 16.viii.1956 Nr Wankl village, on mountain slope c. 5 km SE of Mt Hagen station (LAE); *Millar & van Royen NGF 18566*, 1.ix.1963, Maimbeno, Minj subdistrict (LAE, K); *Millar NGF 37649*, 8.vii.1968, Forest behind Sanctuary, Hagen sub-district (LAE); *van Royen NGF 18269*, 6.ix.1963, Confluent on Warapuri and Warrangga Rivers, Wahgi-Jimmy Divide, N of Nondugl, Minj sub-district (LAE, K); *Vink 16475*, 4.ix.1963, Nona River, Kubor Range (LAE, K); *Womersley NGF 4395*, iv.1951, Nondugl (LAE); *Womersley NGF 4371*, iv.1951, Nondugl (LAE).

### f. var. *yorkensis* R.M. Barker, var. nov.

Varietas nova *H. floribundae*, a var. *velutina*, var. *floribunda* et var. *pubescenti* differt involucro singulari ad nodos omnes, a var. *canescenti*, var. *distanti* et var. *angustifolia* capsulis pubescentibus, a var. *cinerea* et var. *varia* capsulis glanduliferis eglanduliferisque et a var. *neoguineensi* corollis maioribus, pilos glanduliferos ferentibus et filamentis pubescentibus.

*Holotype*: *Clarkson 4567*, 15.x.1982, 112 km W of Merapah on the blazed track to Peret, c. 30 km S of Aurukun, levee of Archer River (AD); *isotypes* n.v.: (BRI, QRS).

Bushy, erect, ?annual sub-shrub to 0.5 m high, or small decumbent herb, sometimes rooting at nodes. *Branches* 4-6-angled, not obviously longitudinally grooved, more or less glabrous or

with very sparse to moderately, dense, weak eglandular hairs. *Leaves* petiolate, petioles on largest leaves to 2 cm long, blade ovate, 2-9 x 1-3 cm, very young leaves with dense mixture of very short, inconspicuously glandular hairs and longer eglandular hairs, older leaves with eglandular hairs either all over or sparsely on petioles, midribs and margins, or more or less glabrous. *Inflorescence* short spike of up to 8 involucre arising in each of upper axils, spike sometimes 1-2 branched, frequently 1-sided and with involucre overlapping or distant, rarely (Anning 232) spikes very condensed, always with single involucre at each node, sometimes appearing paired by condensation of rachis; *rachis* with sparse to moderately dense, long, downturned, eglandular hairs in lower parts of spike, mixed with short, erect, inconspicuously glandular hairs higher up; *involucre subtending bracts* triangular, c. 1 mm long, similar indumentum to rachis. *Involucres* subsessile, 7.5-8.5 mm long, outer surface covered by dense, inconspicuously glandular hairs mixed with longer, sparser, downturned eglandular hairs, rarely also with longer, conspicuously glandular hairs, margins and line of union of bracts white-lined (best seen while involucre are still green), outer bracts joined for  $\frac{1}{2}$  or slightly more of their length; inner bracts slightly shorter than outer. *Calyx* segments shorter than inner bracts, externally with short inconspicuously glandular hairs mixed with much longer eglandular hairs. *Corolla* pinkish-purple with white markings on upper lip near throat; tube 7-8.5 mm long; upper lip 10.5-15 mm long. *Stamens* with hairy filaments. *Capsule* c. 7-8 mm long, apically more or less acuminate, with appressed, long eglandular hairs on apical seed bearing portion mixed with shorter, sparser, conspicuously glandular hairs, particularly near apex. Fig. 36 E.

### Distribution

*H. floribunda* var. *yorkensis* is restricted to Cape York Peninsula of northern Queensland with most collections coming from the western, lower lying regions (Fig. 38). The only exception to this is *Scarath-Johnson 269A* which comes from a plains area to the east of the more mountainous parts. Whether this variety and var. *canescens*, which also occurs in this area but on the eastern slopes, are vicariants can only be determined by more collections and field observations.

### Ecology

Ecological data refer to "loam on a scrubby creek bank" (Anning 232), "shade on the top of a creek bank" (Morton 1187) and "silty clay loam in *Eucalyptus papuana* woodland" (Clarkson 4557). Flowering and fruiting occurs from July to October.

### Notes

1. The variety as constituted here is characterised by the presence of small, conspicuously glandular hairs on the capsule particularly near the apex. These hairs are sometimes relatively dense and easily seen under the microscope (Blake 12615), but in other cases although they are present, they are extremely sparse and difficult to see (Scarath-Johnson 269A and Anning 232). The inflorescence varies within this taxon from a long, lax, panicle-like arrangement of the involucre to a similar, but much more condensed, arrangement of the involucre.

2. It is difficult to find an easily observed character to separate var. *yorkensis* and var. *varia*. The presence of short, conspicuously glandular hairs on the capsules of var. *yorkensis* effectively separates them, but these are difficult to locate because they are both smaller and out-numbered by appressed eglandular hairs. The involucre of var. *yorkensis* tend to be smaller in length and the margin of the outer bracts and their join is white. However, both of these characters show overlap with var. *varia*.

3. Collections by Kenneally from the Mitchell Plateau of the Kimberley region of Western Australia while obviously allied to var. *suaveolens* (q.v., Note 2), are similar in habit

to those of var. *yorkensis*. They possess the same branched and one-sided spikes of involucre and both have conspicuously glandular hairs on their capsules. The Western Australian collections differ in possessing conspicuously glandular hairs on the involucre and rachises, while the Cape York collections possess only short, inconspicuously glandular hairs (although very rarely also having some longer and conspicuously glandular hairs). In addition, the capsules of the former possess longer and more conspicuously glandular hairs mixed with erect eglandular hairs of a similar height, whereas the capsules of var. *yorkensis* have shorter and less conspicuously glandular hairs which are accompanied by long, appressed eglandular hairs.

### *Specimens examined*

QUEENSLAND: *Anning* 232, 16.vii.197, c. 8 km off Bamaga Rd towards Merluna (QRS); *Benson* 590, 6.x.1973, Wenlock River at Moreton Telegraph Office (NSW); *Blake* 12615, 1.viii.1936, Dunbar, Gilbert River Forest (BRI); *Brass* 19688, 26.vii.1948, Wenlock, Batavia River (CANB, K, BRI); *Clarkson* 4557, 15.x.1982, 112 km W of Merapah on the blazed track to Peret, c. 30 km S of Aurukun levee on Archer River (AD); *Flecker* 13226, 23.vii.1947, Archer River (QRS, NSW); *Gittins* 1004, s. dat. (BRI, NSW); *Hann* 52, 4.viii.1873, north of Mitchell [River] (K); *Johnson* s.n., 1891, Stuarts River (MEL 100832); *Morton* 1187, 16.v.1981, York Downs, on Myall Ck National Parks and Wildlife Site W 16, Cape York (MEL); *Ollerenshaw* 547, 11.vii.1980, between Moreton Telegraph Stn and Coen, ¾ km N of Archer River Crossing (CBG); *Scarth-Johnson* 269 A, viii.1976, Marina Plains and Lilyvale (BRI); *Scarth-Johnson* 842 B, 17.x.1979, York Station (BRI); *Scarth-Johnson* 843 A, 17.x.1979, between Wenlock and Jardine Rivers (BRI).

### *g. var. cinerea* R.M. Barker, var. nov.

Varietas nova *H. floribundae*, a var. *velutina*, var. *floribunda* et var. *pubescenti* differt involucre singulari ad nodos omnes, a var. *canescenti*, var. *distanti* et var. *angustifolia* capsulis pubescentibus, a var. *yorkensi* capsulis pilis glanduliferis carentibus, et var. *varia* foliis tomentum velutinum ferrugineum cinereumque ferentibus.

*Holotype*: *Kanis* 1849, 16.vii.1974, road along 7 mile Creek, c. 20 km West of Wollongorang (CANB); *isotype*: (NT).

Erect to semi-erect, spreading, grey-green subshrub, to 1 m tall. *Branches* 4-6-angled, not obviously grooved longitudinally, usually producing a number of short, densely leaved branchlets in upper half, with dense cover of white, very short ('Riversleigh' form), or longer ('Wollongorang' form) appressed eglandular hairs. *Leaves* with 3 mm long petioles, blade linear-lanceolate, 2-8 x 0.3-1.5 cm, dense cover of short, erect, inconspicuously glandular hairs on both surfaces, on upper surface also with much longer, appressed, eglandular hairs most dense on midrib and lateral veins, on lower surface and petioles with very dense cover of long, white eglandular hairs, similar to those on branches, often obscuring short glandular hairs; upper surface green to brownish green; lower surface pale whitish-green. *Inflorescence*, short spikes with 8 involucre arising in each of upper axils, spikes sometimes branched, highly condensed to give axillary cluster of involucre ('Wollongorang' form), or involucre distant along rachis (Riversleigh form); rachis with eglandular indumentum similar to branches, near apex either the same, but denser, or mixed with dense, short, erect, inconspicuously glandular hairs, sometimes also with short, conspicuously glandular hairs; *involucre subtending bracts* small, leaf-like, frequently in unequal pairs, of similar indumentum to rachis. *Involucre* sessile, 6-10 mm long, indumentum on outer surface ('Wollongorang' form) dense, short, erect, inconspicuously glandular hairs mixed with taller (0.1-0.2 mm long) conspicuously glandular hairs, ('Riversleigh' form) short, erect, inconspicuously glandular hairs mixed with short, appressed eglandular hairs and conspicuously glandular hairs, all similar height; outer bracts joined for more than half length; inner bracts slightly shorter than outer. *Calyx* segments shorter than inner bracts, externally covered with short, erect, inconspicuously glandular hairs mixed with sparse, slightly longer, eglandular hairs. *Corolla* purple, mauve or pink with white throat; tube 10-13 mm long; upper lip 13-15 mm long; *Stamens* with hairy filaments. *Capsules* 8.5-10 mm long, apically acute, with few eglandular hairs confined to apex of seed-bearing portion.

### Distribution

*H. floribunda* var. *cinerea* is known from the Riversleigh district of Queensland ('Riversleigh' form) and from the Wollogorang region of the Northern Territory ('Wollogorang' form). Allied collections (see Note 2) come from the Katherine area of the Northern Territory and the Newcastle Ranges of north-west Queensland (Fig. 38).

### Ecology

The Riversleigh collections are all from rocky areas or skeletal soil in limestone hills while the 'Wollogorang' form has been recorded from "steep and stony basalt slope with incipient rainforest growth" (Pullen 9212) and from a "steep, dry, rocky creek bed under vine scrub" (Kanis 1849). The Katherine collections are from the outcrops and steep cliffs of the sandstone ranges associated with Katherine Gorge, with a further collection from a sandstone outcrop at Christmas Creek, north of Katherine. Flowering specimens have been collected between March and July.

### Notes

1. *H. floribunda* var. *cinerea* is distinct by its rusty or greyish velvety tomentum particularly on the leaves and branches. As already shown in the description it is possible that two forms are encompassed here. All of the Wollogorang area collections have involucre condensed into clusters, have a longer eglandular indumentum on the branches and the conspicuously glandular hairs present on the involucre and upper parts of the inflorescence are taller (0.1-0.2 mm long) than the rest of the indumentum. In contrast the Riversleigh area collections have a more lax, panicle-like, arrangement of involucre, a very short eglandular indumentum on the stem and branches and the conspicuously glandular hairs on the involucre and rachis are of a similar height to the rest of the hairs. Further population collections from this area may clarify whether these apparent differences always apply, but at this time the number of collections is not sufficient to justify formalising the taxa.

In addition, relationships between neighbouring varieties need to be investigated. *H. floribunda* var. *velutina* of the Mt Garnett area of coastal eastern Queensland is very similar in habit and indumentum type to var. *cinerea*, particularly the 'Riversleigh' form, and apparently differs only in the number of involucre at each node and the leaves ovate rather than linear-lanceolate. At present there is a disjunction in the distributional ranges of the two varieties (Fig. 38), but collections from the intervening area may indicate intergradation. (see Note 2).

2. Collections from the sandstone regions of the Katherine area in the Northern Territory ('Katherine' form) approach *H. floribunda* var. *cinerea* but differ in the lack of short, erect, inconspicuously glandular hairs on the leaf surfaces; instead they have tall, stout, eglandular hairs. Leaves tend to be ovate and where capsules are present, they have a more prolific cover of eglandular hairs than is usually found in var. *cinerea*. In all characters the Katherine collections are more or less intermediate between *H. floribunda* var. *cinerea* and var. *varia*.

The collection Armit 536 from the Newcastle Range in north-west Queensland similarly approaches var. *cinerea*, but lacks the characteristic short, dense, erect, inconspicuously glandular hairs on the leaves. The linear-lanceolate leaves and the single involucre per node show its affinities to var. *cinerea*, although in location it is closer to the var. *velutina* distribution.

### Specimens examined

#### 'Riversleigh' form

QUEENSLAND: Armit 1010, s. dat. Etheridge Range (MEL); Blake 8647, 20.iv.1935, Riversleigh (BRI); Latz 1713, 23.vi.1971, Lawn Hill Stn (NT); Perry 1433, 11.vi.1971, 30 miles S of Riversleigh Stn (CANB: 2 sheets, K, NSW, MEL).

*'Wollogorang' form*

NORTHERN TERRITORY: *Henshall 444*, 16.vi.1974, Wollogorang (NT); *Kanis 1849*, 16.vi.1974, road along 7 Mile Creek, c. 20 km W of Wollogorang (CANB, NT); *Pullen 9212*, 12.v.1974, c. 21 km W of Wollogorang on road to Calvert Hills, near Redbank Mines (CANB).

*'Katherine' form*

NORTHERN TERRITORY: *R.M. Barker 512*, 9.v.1983, Christmas Creek, 109 km NE of Pine Creek, off road to UDP Falls (AD); *R.M. Barker 521*, 10.v.1983, Katherine Gorge, at top of walk to look-out (AD); *Lazarides 7033*, 8.iii.1964, Katherine Gorge, 15 miles E of Katherine Township (CANB); *Wilson 405*, 21.iii.1965, Tributary of 17 Mile Creek, NE of Katherine (CANB, K, NT).

*H. floribunda* aff. var. *cinerea*

QUEENSLAND: *Armit 536*, s. dat. Newcastle Range (MEL).

h. var. *varia* R.M. Barker, var. nov.

*Hypoestes laxiflora* var.  $\beta$  Nees in A. DC., Prodr 11 (1847) 508, p.p. (with respect to *Armstrong 573* from Port Essington and *Cunningham 189* from Goulbourn Island).

*Hypoestes moschata* F. Muell. & M. Holtze, Vict. Nat. 8 (1891) 115 (name only); F. Muell., Select Extra-trop. Pl. 8th edn (1891) 529; F. Muell., Proc. Linn. Soc. N.S.Wales 6 (1892) 474; F. Muell., Select Extra-trop. Pl. 9th edn (1895) 261.

*Lectotype* here designated: *M. Holtze s.n.*, 1891, Inland from Port Darwin (MEL 601964); *isolectotypes*: (K, NSW); *syntypes*: ?*M. Holtze 295*, 1883, Port Darwin (MEL); *possible syntype*: *N. Holtze 1320*, s. dat. Botanic Gardens, Darwin (MEL).

*Hypoestes floribunda* '2. *paniculata*' auct. non Benth.: Benth., Fl. Austral. 4 (1868) 554, p.p. (as to *Armstrong 573* and ?*Cunningham 189*), nom. illeg. — *H. floribunda* var. *paniculata* (Benth.) Ewart & Davies, Fl. N. Terr. (1917) 252, nom. illeg. (see typification of *H. floribunda*).

*Hypoestes floribunda* var. *pubescens* auct. non Benth.: Benth., Fl. Austral. 4 (1868) 554, p.p. (as to *Kinley* collection).

*Hypoestes floribunda* "1. *densiflora*" auct. non Benth.: Benth., Fl. Austral. 4 (1868) 554, p.p. (with respect to *Martin* collection): —

Varietas nova *H. floribundae*, a var. *velutina*, var. *floribunda* et var. *pubescenti* differt involucri singulari ad nodos omnes, a var. *canescenti*, var. *distanti* et var. *angustifolia* capsulis pubescentibus, a var. *yorkensi* capsulis pilis glanduliferis carentibus, a var. *cinerea* foliis tomento velutino, ferrugineo cinereove carentibus, a var. *suaveolenti* axibus floralibus pilis eglandulos longioribus carentibus, et a var. *neoguineensis* corollis maioribus, pilis glanduliferis ferentibus et filamentis pubescentibus.

*Holotype*: *McKean B602*, 8.vi.1972, 3 miles NW Adelaide River Township (CANB); *isotypes*: (DNA, NT).

Erect perennial herb or subshrub, 0.3-0.9 m high, sometimes with lower branches decumbent. *Branches* 4(-6)-angled, sometimes obscurely grooved longitudinally on faces, short, dense, eglandular hairs rarely mixed with longer, often appressed against stem, rarely very early glabrescent (see Note 1a). *Leaves* petiolate, blade ovate to broad-lanceolate, 2-11 x 1-4.5 cm, crenulate or more or less entire, short or long eglandular hairs all over, sometimes mixed with short, dense, inconspicuously glandular hairs when young, glabrescent slowly or rarely quickly (Note 1a). *Inflorescence* a leafy panicle in terminal parts of plant, usually consisting of single spike, or more rarely a raceme of spikes in each axil, spikes with one involucre per node, when single, frequently 1-sided and of up to 8 involucre which just overlap at consecutive nodes, sometimes greatly condensed (particularly in beach or dune localities, Note 1c) by contraction of rachis such that involucre overlap greatly and cluster within axil (*Specht 836*, *Higginson NSW 151887*) or involucre more than 8 and closer together (*Butler s.n.*, *Burbidge 1483*);

*rachis* with similar indumentum to branches, sometimes with short, erect, inconspicuously glandular hairs higher up, rarely (Note 1b) mixed with longer, conspicuously glandular hairs; *involucre subtending bracts* small and leaf-like at base of spike, triangular to linear-lanceolate, 1-2 mm long towards apex, similar indumentum to rachis. *Involucres* 7-10 (-12) mm long, sessile or only shortly pedunculate, rarely with peduncles to 3 mm long, in Tortilla Flats (Northern Territory) peduncles (2) 4-8 (-12) mm long (Note 1d), outer surface rarely mostly glabrous (Note 1a), usually bearing downturned eglandular hairs similar to those on branches, sometimes mixed with short, erect, dense, inconspicuously glandular hairs usually confined to junction of outer bracts, sometimes sparsely all over; outer bracts fused slightly more than half length; *inner bracts* usually slightly shorter than outer, very rarely just exceeding them, with short dense, erect, inconspicuously glandular hairs on outer surface, sometimes mixed with longer, conspicuously glandular hairs. *Calyx* segments shorter than inner bracts, short, erect, inconspicuously glandular hairs on outer surface. *Corolla* pink, purple, mauve or lilac, upper lip with white area at base, externally with mixture of glandular and eglandular hairs; tube c. 10-12 mm long; upper lip 12-16 mm long. *Stamens*: filaments pubescent. *Capsule* 7.5-9 mm long, apically acute, with long, appressed or erect eglandular hairs all over upper, expanded, seed-bearing portion.

### Typification

*H. moschata* F. Muell. & Holtze (see also Note 2)

There are three sheets in MEL and one in K and NSW which are annotated by Mueller as "H. moschata FvM & Holtze". Material on the sheet *Holtze MEL 601964* was displayed by Mueller at a gathering of Victorian naturalists in 1891 (Anon. 1891) with the accompanying note: "New to Science. For notes on this musk-scented plant see new edition Select Plants page 529, the book is on this table".

In the publication referred to (Mueller 1891), the protologue contains the mandatory description of the plant, albeit brief, the entry reading as follows:

"Arnheims Land. This perennial herb is pervaded by a singularly penetrating musk-scent, so that from the foliage a powerful cosmetic can be distilled, the odorous principle not being subject to chemical decomposition through gentle heat".

A note is made on a letter accompanying another sheet, *MEL 601966* (see Note 2) that the perfume of the plant can be used to distinguish it from *H. floribunda* R. Br. It is probable that this undated letter and the accompanying specimen from Nicholas Holtze (*Holtze 1320*) were received after 1891 as the original collections seen by Mueller had been made by Maurice Holtze (the father of Nicholas and both of them curators of the Darwin Botanic Garden) in 1883 and 1891. The letter by Nicholas states, "My father informs me that you have decided to erect this into a distinct species under the name of *Hypoestes moschata* . . . . Specimens enclosed . . . are from plants growing in this garden".

The specimen which had been on display (*M. Holtze MEL 601964*) thus seems best candidate for lectotype, particularly as it is represented by a duplicate in K and NSW. It possesses mature capsules and seed and consists of a single branch with a number of involucre.

### Distribution

*H. floribunda* var. *varia* is mostly known from the northern tropical areas of the Northern Territory, with a widely disjunct occurrence near Broome in Western Australia (Fig. 37).

### Ecology

The variety is recorded in about half of the collections from creek banks; most of the remaining collections come from sandstone or usually from areas of sandy soil in coastal dunes

or deep sandy loam in *Eucalyptus-Callitris* association. Other habitats mentioned are the edge of rainforest and on ironstone. Flowering specimens have been collected in practically all months of the year, but most commonly after the monsoon in April to September.

### Notes

#### 1. Variation in *H. floribunda* var. *varia*

This variety comprises a number of morphologically divergent entities, indicated below, which often show relationships to other varieties. In some cases these may prove worthy of formal taxonomic recognition. However, at this stage, none are easily separable from the variety as a whole and they are not as distinct as the varieties already recognised. For specimens which intergrade with var. *angustifolia* and var. *cinerea* see after treatments of these varieties.

a. Collections from Melville and Goulbourn Islands and from Port Essington (*Stocker & Fox* 839, *Cunningham* 189, *Armstrong* 573) have some involucre tenders to be almost glabrous. Others have a mixture of longer conspicuously glandular hairs and short, inconspicuously glandular hairs (sometimes the former are lacking) at the join of the outer bracts of the involucre, with a few, sparse, short, eglandular hairs on the rest of the involucre. Branches and leaves also tend to be glabrous, although an inspection of young leaves and bracts sometimes shows a dense cover of the eglandular hairs which are typical of var. *varia*. Thus, these collections may be more rapidly glabrescent than the rest. This entity shows closest affinities with the entity of var. *varia* which includes the type (the typical entity).

b. *Dunlop* 5019, *Telford* 7826 and *Must* 1120 from the Nourlangie Rock area of Northern Territory conform with the typical entity of var. *varia* except for the possession of short, conspicuously glandular hairs spreading from the involucre on to the rachis. This may reflect their habitat as two of the collections are unusual in being recorded from within closed forest.

c. The Burbidge and Butler collections from 80 Mile Beach in Western Australia have more crowded involucre along the rachis and a very dense mixture of short, erect, inconspicuously glandular hairs with slightly longer upright eglandular hairs on the rachises and young leaves. The only other collections to have such densely crowded inflorescences are *Latz* 3422, *Specht* 836 and *Higginson* (NSW 151877) from the Northern Territory, but these lack the inconspicuously glandular hairs on the leaves and rachis and the involucre tend to be more clustered than in the Western Australian collections: the eglandular hairs on the rachis are appressed.

The Western Australian collections *Martin* 34 from Lagrange Bay, *Kenneally* 8537 from Cable Beach and *Tepper* 20 from Roebuck Bay possess inflorescences with a similar indumentum to that of the Burbidge and Butler collections. However, the leaves tend to agree more with var. *angustifolia* in being gland-dotted and approaching an almost glabrous state. In young parts they have appressed eglandular hairs (*Martin* 34) or dense inconspicuously glandular hairs (*Tepper* 20).

All the above collections are from beach localities and this may account for their similar indumentum and more clustered involucre.

d. The only specimens in which the involucre are long pedunculate are *Pickering* 110 from Tortilla Flats in Northern Territory, in which they are (2-) 4-8 (-12) mm long, and *Dunlop* 2710 from Maria Island, Northern Territory, with them (0.5-) 1.5-2.5 mm long. In other respects, the two vary from each other as the Dunlop collection has the outer surface of the



involucres with short, erect, dense, inconspicuously glandular hairs and longer, conspicuously glandular hairs mixed with eglandular hairs, and the calyx segments, which in some cases exceed the involucres, often have conspicuously glandular hairs as well as the short, erect, inconspicuously glandular hairs. In contrast the Pickering collection lacks any conspicuously glandular hairs and the outer surface of the involucre often has only short downturned eglandular hairs, while the inner bracts and calyx segments have short, inconspicuously glandular hairs. In addition the inflorescence is much more branched, with 1-2 panicles arising within each axil in the upper parts of the plant. The involucres tend to be narrower than in the Dunlop collection, with the lobes long and tapering and never exceeded by the calyx. Thus it is possible that this is another form that can be delimited from typical var. *varia*, but further collections are necessary. My own collection (Barker 376) from Tortilla Flats approaches *Pickering 110* in possessing the longer peduncles but it is only in an early stage of flowering and the inflorescences are not as highly branched.

e. The collection *Fitzgerald 108* from Broome is unique in the combination of characters shown. It has characteristics of var. *distans*, typical var. *varia* and var. *angustifolia*. Stems are usually glabrous apart from a few, very sparse, long, downturned, eglandular hairs. Leaves are also usually glabrous and gland-dotted, while the rachis has an extremely short, upright, glandular indumentum, more dense on the young parts and spreading onto the outer surface of the involucres where it may be mixed with almost sessile, conspicuous glands. Capsules have eglandular hairs on the expanded upper seed-bearing portion.

## 2. *Hypoestes moschata* F. Muell. & M. Holtze

The five collections of what Mueller called *Hypoestes moschata* seem to be no different from the rest of the collections from the Darwin area, except that in a letter (included on *Holtze 1320*) Nicholas Holtze commented that it was "locally known as the 'musk plant' from its delicate perfume, which appears to reside in the leaves and which is freely communicated to articles of cloth by simple contact. It is no doubt very nearly related to *H. floribunda* R. Br. which however has not the least perfume. *H. moschata* so far as known has rather a restricted range upcountry while *H. floribunda* is very abundant about the coast in the vicinity of Pt Darwin and onward to the Daly River".

None of the later collections of *H. floribunda*, of which there are many, refer to a perfume, and so in the absence of any other distinguishing character *H. moschata* is treated as a synonym of var. *varia*. Mueller (1892) later cast some doubt on the species himself, suggesting that it could perhaps not be "systematically" separated from *H. floribunda*, only industrially i.e. by its musk-scent.

I have chosen not to use the epithet 'moschata' at varietal level, even though it is the earliest name available, since the perfume alluded to in the original description seems to be usually absent in the variety.

### *Representative and cited specimens examined* (68 specimens seen).

NORTHERN TERRITORY: *Armstrong 573*, v.1840, Point Smith, Port Essington (K—2 sheets p.p.); *R.M. Barker 359*, 29.iv.1983, Middle Creek, on road to Douglas Daly Research Farm (AD); *R.M. Barker 376*, 30.iv.1983, Adelaide River, 0.7 km E of Tortilla Flats Research Stn (AD); *Cunningham 189*, 1818, Goulbourn Island (BRI, BM, K: 2 sheets, NSW, MEL); *Dunlop 2710*, 8.vii.1972, Maria Island (CANB, NT); *Dunlop 5019*, 15.vii.1978, Little Nourlangie Rock (DNA); *Higginson s.n.*, 18.viii.1969, Wirowawoi Lagoon, Gove (NSW 15188); *Jackson 1055*, 5.vi.1967, Rum Jungle, c. 65 km SSE of Darwin (AD); *Latz 3422*, 5.vii.1972, Wessel Island (CANB, NT); *Maconochie 1537*, 20.vi.1972, 10 miles S Cape Arnhem (CANB, NT); *Maconochie 2084*, 2.vii.1974, Elcho Island, Warangaiya Lagoon (BRI, NT); *McKean 1181*, 28.ix.1973, Daly River Crossing, Daly River Rd (CANB); *Martensz AE 156*, 15.vii.1972, Vicinity of Cannon Hill (CANB, DNA, NT); *Muspratt 55068*, 24.iv.1963, Roadside, Darwin rainforest (DNA); *Must 1120*, 22.v.1973, Nourlangie Rock (DNA, NT); *Ollerenshaw 1631A*, 20.v.1975, S. Alligator River at Pine Ck-Oenpelli Road Crossing (CBG); *Pickering 104*, 10.v.1966, Koolpinyah Stn, 7 m SE of homestead

(NT); *Pickering* 110, 7.vi.1966, Tortilla Flats (CANB, NSW); *Specht* 836, 6.viii.1948, Yirrkala (BRI, CANB, K, NSW); *Stocker & Fox* 839, 29.v.1967, Tip of Karslake Peninsula, Melville Island (BRI, DNA, NSW, NT); *Telford* 7826 & *Wrigley*, 20.iv.1980, Little Nourlangie Rock (CANB, CBG, NSW).

WESTERN AUSTRALIA: *Burbidge* 1483, 16.vii.1941, Anna Plains Station (PERTH: 2 sheets); *Butler s.n.*, vii.1963, Cape Bossut, Fraser Downs (PERTH); *Fitzgerald* 108, iv.1905, Broome (PERTH); *Kenneally* 8537, 1.vii.1982, Cable Beach (near Broome) (PERTH); *Martin* 34, s. dat. Cape Lagrange (MEL); *Tepper* 20, viii.1889, Roebuck Bay (MEL).

i. var. *angustifolia* Benth., Fl. Austral. 4 (1868) 554.

*Lectotype here designated: Mueller s.n.*, s. dat. Fitzmaurice River (K p.p.); *isolectotype: (MEL 601942); syntypes: Mueller s.n.*, s. dat. Upper Victoria River (K p.p., MEL 601941).

Straggly or erect, often greyish, shrub to 0.9 m high. *Branches* obscurely 6-angled, often with whitish scurf, otherwise completely glabrous or rarely (*Gardner 11807*) with sparse downturned 3-4-celled eglandular hairs at nodes and on petioles in younger parts. *Leaves* usually sessile, sometimes shortly petiolate, blade usually lanceolate, rarely ovate, 2.4-11 x 0.6-5 cm, glabrous or rarely (*Forbes 1981*) young leaves with short, erect, inconspicuously glandular hairs, usually conspicuously (hand lens) gland-dotted on both surfaces, sometimes glaucous. *Inflorescence* a 1-sided spike of up to 9 involucre in each of upper axils, involucre single at each node, overlapping for  $\frac{1}{4}$  -  $\frac{1}{2}$  of their length; *rachis* glabrous below, higher up with a few, short inconspicuously glandular hairs, towards apex mixed with longer, moderately dense, conspicuously glandular hairs; *involucre-subtending bracts* triangular, glabrous in lower parts of inflorescence, with short, erect, inconspicuously glandular hairs and sometimes with eglandular hairs on margins. *Involucres* sessile, 8-12 mm long, outer surface with dense, short, erect, inconspicuously glandular hairs mixed with longer conspicuously glandular hairs; outer bracts joined for half their length; inner bracts shorter than outer. *Calyx* segments shorter than inner bracts, with sparse, short, erect, hairs on outer surface, ciliate on margins. *Corolla* purple, pink or violet, external surface with glandular and eglandular hairs; tube 9-12 mm long; upper lip 12-16 mm long. *Stamens* with hairy filaments. *Capsule* 9-11 mm long, acute, glabrous.

### Typification

There are three sheets available for lectotypification of Bentham's var. *angustifolia*. Of these, the material in K is the best, although the sheet is a mixture of two Mueller collections. Accordingly the two left hand side specimens from the Fitzmaurice River have been designated as lectotype since they are in superior condition to the Upper Victoria River collection on the right hand side.

### Distribution

*H. floribunda* var. *angustifolia* is known from very few collections from the Kimberley region of Western Australia and the Victoria River area of Northern Territory (Fig. 38).

### Ecology

As with other varieties of *H. floribunda*, var. *angustifolia* is found in areas which are associated with water, e.g. falls, creeks and gorges. Flowering specimens have been collected between April and August.

### Notes

*H. floribunda* var. *angustifolia* is immediately distinguishable by its glabrous, often glaucous, gland-dotted leaves in contrast to the indumentum on the floral parts which consists of short, dense, inconspicuously glandular hairs mixed with longer, very conspicuously

glandular hairs. This indumentum on the floral axes distinguishes the variety from the glabrous var. *distans* to which it is most closely related and with which it intergrades (see below). The variety also probably intergrades with var. *suaveolens* or the typical var. *varia* (see below) from both of which it should be easily distinguished by its glabrous capsules.

(a) Specimens intermediate between var. *angustifolia* and var. *distans*

The PERTH sheet of *Kenneally 3010* agrees with typical var. *angustifolia*. However, the CANB duplicate lacks any indumentum on the rachis and involucre subtending bracts, the involucre often having only a sparse, inconspicuously glandular puberulence mixed with a few, taller, conspicuously glandular hairs, characteristics which approach var. *distans*. Other collections (*Rankin 2202*, *Barker 542*, *Hartley 14435*, *Forbes 1981*) also possess glabrous rachises and involucre subtending bracts, the involucre tending to be more distant than in var. *angustifolia*, but not as distant as in var. *distans* and they have a sparser covering of hairs than var. *angustifolia*, but are not usually completely glabrous as in var. *distans*. Some of the collections also have a very few eglandular hairs on the capsules, a characteristic which does not agree with either var. *angustifolia* or var. *distans*, but possibly indicates a link with the group of specimens discussed below in Note 1b. This array of characteristics cannot be related to geographical locality as all five collections are from diverse areas in Western Australia and the Northern Territory.

(b) Relationship to var. *suaveolens*

Two collections, *Lullfitz 66051* and *Beard 7029* which are further discussed and treated under var. *suaveolens*, have some characteristics of var. *angustifolia*. The Beard collection from Port Warrender in the Admiralty Gulf has floral axes with the distinctive long eglandular hairs of var. *suaveolens*, but in the young vegetative parts it has the glabrous, and gland-dotted leaves typical of var. *angustifolia*. The Lullfitz collection from north of Wyndham in the Cambridge Gulf almost completely lacks the distinctive eglandular hairs of var. *suaveolens*, although the floral axes are otherwise similar in indumentum to var. *suaveolens*. As with the Beard collection, it too possesses glabrous, glaucous and gland-dotted leaves characteristic of var. *angustifolia*. Capsules in both cases are pubescent, a characteristic which aligns the collections with var. *suaveolens*, since var. *angustifolia* possesses glabrous capsules. It seems that the Beard collection might occupy an intermediate position between var. *angustifolia* and var. *suaveolens*, apart from the presence of the distinctive long eglandular hairs which have led to it being treated here as part of var. *suaveolens*. On the other hand the Lullfitz collection, by the presence of glandular hairs on the capsule, seems to be intermediate between var. *angustifolia* and the *Kenneally* collections from the Mitchell Plateau. These last collections, discussed further under var. *suaveolens* Note 3, are probably deserving of varietal status because of the dense glandular hairs on the capsules.

(c) Specimens with affinities to var. *angustifolia*

A series of collections from the Kimberleys region of Western Australia, while having closest affinities with var. *angustifolia* do diverge in some characteristics, with pubescence on the branches, leaves and capsules possibly indicating approaches to var. *varia*, or even var. *suaveolens*.

*Bradshaw MEL 100841* and *George 12268* from the Prince Regent River area and *Kenneally 5001* from the Mitchell Plateau resemble var. *angustifolia* in the presence of conspicuously glandular hairs on the rachis and involucre, but they are not glabrous on the branches and leaves, possessing instead a short, erect and dense glandular or eglandular indumentum on these parts. The *Bradshaw* and *Kenneally* collections also diverge from var. *angustifolia* by pubescence on the capsules. Two other collections from this area, *Bradshaw &*

*Allen MEL 100840* and *Hartley 14805*, also resemble var. *angustifolia* except that they possess a sparse, eglandular pubescence on the leaves and branches and the leaves are not gland-dotted. Capsules are lacking on both collections.

Another group of collections, *Weston 12320* from the Lake Argyle area and *Telford 6178* and *George 1368 & 13968* from the Carson Escarpment also differ from var. *angustifolia* by possessing sparsely pubescent capsules.

### *Specimens examined*

#### *H. floribunda* var. *angustifolia*

NORTHERN TERRITORY: *Mueller s.n.*, s. dat. viii.1885. Near the Fitzmaurice R. (MEL 601924, K); *Dr M. s.n.*, s. dat. Upper Victoria R. (MEL 601941, K); *Perry 2268*, 27.iv.1949, 40 m W of Wavehill Police Stn (CANB, MEL, NSW); *Perry 2384*, 3.vii.1949. Limbunya Stn, (BRI, CANB — 2 sheets, MEL, NSW).

WESTERN AUSTRALIA: *Anon s.n.*, s. dat. Kimberley District (CANB); *Fitzgerald 618*, v.1905. Devils Pass, Napier Range (PERTH); *Forbes 2333*, 10.vi.1984, Carson Escarpment, gully below Wonjarring Falls, 4 km NNE Face Point, Drysdale R. National Park boundary (AD); *Forrest s.n.*, 1879. Lat. 16° 25' Long. 130° 35'. (MEL 100832); *Fuauux c.c.c.*, ix.1942, between Darwin and Larrimah (MEL 100866); *Gardner 7188*, 17.v.1944, Brook Creek, East Kimberleys (PERTH); *Gardner 11807*, 25.iv.1952, Barker Gorge, Napier Range (PERTH); *Gardner 12340*, 29.iv.1960. Napier Range nr Springs Stn (PERTH); *Gittins 1387*, vii.1967, Ord R. Station (BRI, NSW, PERTH); *Johnston s.n.*, s. dat. Near Cambridge Gulf (MEL 100826); *Kenneally 3010*, 3.viii.1975. Boiga Falls, Drysdale R. Nat. Park (PERTH); *Nyulasy s.n.*, 1887. Kimberley district (MEL 100791, MEL 100839); *O'Donnell s.n.*, 1886. Near the Ord R. (MEL 100800, MEL 100801); *Perry 2384*, 7.vii.1949. 26 m N of Nicholson Stn (CANB — 2 sheets, NSW, NT, MEL, PERTH).

#### Specimens intermediate between var. *angustifolia* and var. *distans*

NORTHERN TERRITORY: *R.M. Barker 542*, 11.v.1983, 27.5 km E of Daly Waters along the Carpentaria Hwy (AD); *Rankin 2202*, 25.iv.1979, 2 km N of Nabarlek (AD, CANB, DNA).

WESTERN AUSTRALIA: *Hartley 14435*, 10.iii.1978, base of Northern Carr Boyd Ranges, bordering the Ord River (CANB); *Forbes 1981*, 13.v.1984, Winnama Gorge above Winnama Spring, more or less 17.5 km S Turkey Creek (AD).

#### Specimens with affinities to var. *angustifolia*

WESTERN AUSTRALIA: *Bradshaw s.n.*, 1891, Prince Regent River (MEL 100841); *Bradshaw & Allen s.n.*, 1891, Prince Regent River (MEL 100840); *George 12268*, 14.viii.1974, Bushfire Hill, Prince Regent River Reserve (PERTH); *George 13638*, 10.viii.1975, Glider Gorge, Carson Escarpment, Drysdale River National Park (CANB, PERTH); *George 13968*, 17.viii.1975, Coucal Gorge, Carson Escarpment (PERTH); *Hartley 14805*, 27.iii.1978, above the headwaters of the Helby River (CANB, NT, PERTH); *Kenneally 5002*, 17.vi.1976, Mitchell Falls, Mitchell Plateau (PERTH); *Telford 6178 & Butler*, 27.vii.1977, Carson Escarpment, 36 km E of new Theda homestead, gorge near Wonjarring (CBG); *Weston 12320*, 6.v.1980, Kimberlite Pipe Gap, at head of Smoke Ck, SW of Lake Argyle (PERTH).

j. var. *distans* (Benth.) Ewart & Davies, Fl. North. Terr. (1917) 252.

*Hypoestes floribunda* R. Br. "3. *distans*" Benth., Fl. Austral. 4 (1868) 554. — *H. distans* (Benth.) Domin, Biblioth. Bot. 89 (1929) 606.

*Lectotype here designated: A. Cunningham 172*, 1820, Hunters River, NW Coast (K); *isolectotypes: (K, MEL, BRI).*

*H. laxiflora* var.  $\beta$  Nees in A. DC., Prodr. 11 (1847) 508 p.p. (as to Cunningham collection from Hunter's River).

Herb or spindly shrub, c. 0.3 m or more high. Branches 4-6-angled, completely glabrous. Leaves rarely present, petiolate, blade linear-lanceolate to ovate, c. 5-6 x 0.5-2.5 cm, completely glabrous, gland-dotted. Inflorescence long, sparse, axillary panicles of involucre, involucre one at each node, distant from each other, not overlapping, rachis glabrous; involucre-subtending bracts more or less linear to narrowly triangular, 1-3 mm long, glabrous. Involucres

9-10 mm long, more or less sessile, sometimes shortly pedunculate, outer bract joined for  $\frac{1}{2}$  or more of length; *inner bracts* slightly shorter than outer, externally with short, erect, inconspicuously glandular hairs, with longer eglandular hairs on margins. *Calyx* segments slightly shorter than bracteoles, lax eglandular hairs all over outer surface, sometimes mixed with short, erect, inconspicuously glandular hairs. *Corolla* white or pale cream, suffused purple externally, with glandular and eglandular hairs; tube 8-11 mm long; upper lip 12.5-19.5 mm long. *Stamens*: filaments sparsely pubescent. *Capsule* c. 10 mm long, acute, externally glabrous.

### *Distribution*

*H. floribunda* var. *distans* is known by only a few collections from the Kimberley region of Western Australia (Fig. 38). Two other collections with affinities to the variety come from the Northern Territory (Note 2).

### *Ecology*

Nothing is known of the ecology of this variety except that, as with other varieties of *H. floribunda*, it occurs near water.

### *Notes*

1. It is possible that var. *distans* is only a glabrous form of var. *angustifolia* as seen by the collections which are intermediate between them (q.v. Note 1a). Field observations are required to determine the final status of var. *distans*.

2. The collections, *Henshall 1838* and *Muspratt SS051*, from Wangi and Tipperary south of Darwin, like var. *distans* possess glabrous leaves and stems, are gland-dotted and some of their involucre are completely glabrous. However, other involucre on the same plant have a mixture of short, erect, inconspicuously glandular hairs and longer conspicuously glandular hairs and, particularly in *Henshall 1838*, the involucre are not sessile but on peduncles up to 12 mm long. The Muspratt specimen has involucre varying from more or less sessile to peduncles up to 4 mm long, but in addition has a few, very sparse, short (-almost sessile) glands or glandular hairs near the apex of the capsule. There is no sign of these in the Henshall collection. Further collections are required to establish whether these reflect a widely variably var. *distans*, or a distinct variety.

### *Specimens examined*

WESTERN AUSTRALIA: *Beard 8302*, 13.ix.1978, near Mitchell R. Falls, Mitchell Plateau (PERTH); *Cunningham 171* (p.p.), 1820, Montagu Sound (BRI p.p., BM p.p., MEL); *Cunningham 172*, 1820, Hunters River, NW Coast (BRI, BM, K (2 sheets), MEL); *Kenneally 4806*, 13.vi.1976, Camp Ck., Mitchell Plateau, NW Kimberleys (CANB, PERTH).

### *Specimens aff. var. distans*

NORTHERN TERRITORY: *Henshall 1838*, 30.v.1978, Wangi Stn, Tolmer Falls (CANB, MEL, NT); *Muspratt SS051*, 5.xi.1964, Tipperary (DNA).

k. var. *suaveolens* (Gardner) R.M. Barker, comb. et. stat. nov.

*Hypoestes suaveolens* Gardner, Forests Dept. Bull. 32 (1923) 91; C.A. Gardner, Enum. Plant. Austral. Occidentalis (1931) 119; J.S. Beard, West Austral. Pl. 2nd ed. (1970) 119; J. Green, Census Vasc. Pl. W. Austral. (1981) 95.

*Holotype*: *Gardner 1527*, 12.viii.1921. Vansit[art] Bay, Kimberley (PERTH); isotype: (PERTH).

Erect shrub or herb, to 1.5 m high. *Branches* 4-6-angled, dense cover of appressed eglandular hairs, rarely (*Beard* 7029) completely glabrous. *Leaves* shortly petiolate, blade lanceolate to elliptic, 1.5-13.5 x 0.5-4.5 cm, rarely (*Beard* 7029) glabrous and young parts conspicuously gland-dotted, usually older parts with cover of downturned eglandular hairs, sparse to dense all over, most dense on petioles, midrib, lateral veins and margins, younger leaves also with dense short, erect, inconspicuously glandular hairs, rarely (*Kenneally* 5197) with longer conspicuously glandular and longer eglandular hairs similar to those on rachis. *Inflorescence* 1-sided spikes or spike-like panicles of up to 7 involucre in each of upper axils, involucre single at each node, always partially overlapping; *rachis* with short, erect, inconspicuously glandular hairs, mixed with longer (0.1-0.2 mm long) conspicuously glandular hairs and sparser much longer (0.7-1.4 mm long) slender, readily visible eglandular hairs, *involucre-subtending bracts* triangular, c. 2 mm long, similar indumentum to rachis. *Involucres* sessile, 10-20 mm long, external indumentum similar to rachis and subtending bracts; outer bracts joined for 1/3-1/2 of their length; inner bracts shorter than outer. *Calyx* segments shorter than bracts, outer surface with moderately dense, short, erect, inconspicuously glandular hairs, sometimes mixed with few longer, conspicuously glandular hairs. *Corolla* lilac, purple or mauve or (*Gardner* 1527), white with purple blotch on upper lip, externally with glandular and eglandular hairs; tube 9-11 mm long; upper lobe 13-16 mm long. *Stamens* with pubescent filaments. *Capsule* c. 10.5 mm long, apically acute, erect eglandular hairs in upper half, rarely mixed with a few inconspicuous shorter, glandular hairs (*Kenneally* 5197). Fig. 36 C.

### Distribution

*H. floribunda* var. *suaveolens* is known only from a few collections from land bounding the Admiralty Gulf in the Kimberley region of north western Australia (Fig. 37).

### Ecology

Some collections come from coastal areas, annotations including "near saline mangrove flat" (*Kenneally* 5197) and in "monsoon forest on the coast" (*Beard* 7029). As well as this the variety has been noted from a "vine thicket" (*Beard* 8529), from "low open forest of *Eucalyptus tectifica* and *E. foelscheana* with a dense understorey of cane grass . . . creek bed lined by vine thicket species such as *Mimusops*" (*Kenneally* 8195) and from "rocky elevations in sandy soil, among quartzite rocks" (*Gardner* 1527, fide *Gardner* 1923). Flowering May-August.

### Notes

1. Though quite distinct from all other varieties of *H. floribunda* by its long, readily visible eglandular hairs on the floral axes, var. *suaveolens* could not be maintained at specific level as it is no more distinct than any of the other infraspecific taxa. The presence of a few of the distinctive long hairs in *Lullfitz* 6605 indicates possible intergradation between this variety and var. *angustifolia* (Note 3). In addition the variation encountered within the variety (Note 2) and the undecided status of the *Kenneally* collections from Mitchell Plateau which have affinities to var. *suaveolens* (Note 3) contributed to the decision to reduce the taxon in rank.

2. Most collections of var. *suaveolens* from the Mitchell Plateau area vary from the type, which came from the same region, in being much less robust. Whereas *Gardner's* type specimens and *Forbes* 2193, also from Vansittart Bay, are woody and from dense shrubs of 1 metre height, the other collections refer to the habit as a herb or soft shrub to 50 cm high. In the latter collections the rachis of the inflorescence is longer and more delicate with involucre 10-13 mm long compared with 16-19 mm in the type specimens. *Beard* 7029 diverges further from the type by its glabrous stem and leaves, this possibly displaying a relationship between var. *suaveolens* and var. *angustifolia* (see Note 1b of var. *angustifolia*). More collections and field work are required to document the variability of var. *suaveolens*.

### 3. Specimens with affinities to var. *suaveolens*

*Lullfitz 66051* from the Western Australian coast north of Wyndham, has very few of the long eglandular hairs so characteristic of var. *suaveolens* on the lowest parts of the rachis. Its stems and leaves are glabrous, which allies it with var. *angustifolia* (q.v., Note 1b), as does the indumentum of mixed, short, inconspicuously glandular hairs and longer conspicuously glandular hairs on the rachis. Similarly *Forbes 2085*, from Vansittart Bay, lacks any of the characteristic long, eglandular hairs of var. *suaveolens*, and it shares with the Lullfitz collection an approach to var. *angustifolia* by more or less glabrous leaves and the distinctive indumentum on the involucre. Both collections differ from either variety by the presence of conspicuously glandular hairs on the capsules, var. *angustifolia* having glabrous capsules and var. *suaveolens* eglandular pubescent capsules.

The only other taxa of *Hypoestes* in Western Australia to have conspicuously glandular hairs on their capsules are *H. sparsiflora* p.p. (only the George collections of this species possess glandular hairs on their capsules, q.v.) and some collections, all by Kenneally and all from the Mitchell Plateau, which are temporarily placed here under var. *suaveolens*. These latter collections all possess moderately dense, long (0.1–0.4 mm), stout, 3–4-celled, often downturned, eglandular hairs on the stems and leaves. Similar hairs are found on the rachis, involucre subtending bracts and the external surface of the involucre, where they are mixed with conspicuously glandular hairs of a similar height. The long eglandular hairs of var. *suaveolens* are lacking completely and the nature of the indumentum on the branches and leaves is different. Despite this, they seem to resemble most closely this variety, as they differ considerably from *H. sparsiflora* by their more crowded and larger involucre. However, field work in this area is desirable to determine whether they are worthy of distinction as another variety. The glandular hairs on the capsules and the possibly distinctively coloured M-shape on the upper lip of the corolla should serve to separate the Mitchell Plateau collections from other varieties, although the latter character needs wider investigation. The Lullfitz and Forbes collections seem to represent an intermediate stage between var. *angustifolia* and the Mitchell Plateau collections (as discussed in Note 1b under var. *angustifolia*).

### *Specimens examined*

WESTERN AUSTRALIA: *Beard 7029*, 11.vi.1974, Port Warrender, N. Kimberleys (DNA, NSW, PERTH); *Beard 8529*, 17.v.1979, Lone Dingo Plateau, Mitchell Plateau (PERTH—1 duplicate); *Forbes 2193*, 28.v.1984, Bougainville Peninsula; Seaflower Bay in Vansittart Bay, 2 km WSW August Point (AD); *Gardner 1027* [= 1527], 12.viii.1921, Vansittart Bay, Kimberley (PERTH: isotype); *Gardner 1527*, 12.viii.1921, Vansittart Bay, Kimberley (PERTH: holotype); *Kenneally 5197*, 21.vi.1976, Port Warrender, Mitchell Plateau, W. Kimberleys (CANB (n.v.), PERTH); *Kenneally 8109*, 25.iv.1982, Lone Dingo approx. 25 km NNW of mining campsite, Mitchell Plateau (PERTH); *Kenneally 8195*, 1.v.1982, 3 km W of Walsh Point, Port Warrender (PERTH).

### Specimens with affinities to *H. floribunda* var. *suaveolens*

WESTERN AUSTRALIA: *Forbes 2085*, 22.v.1984, Cone Mountain on peninsula between Vansittart Bay and Napier Broome Bay, more or less 25 km WNW Kalumburu (AD); *Kenneally 6613*, 16.v.1978, Mitchell Plateau (PERTH); *Kenneally 8108*, 24.iv.1982, 0.5 km SE of mining camp, Mitchell Plateau (PERTH, AD); *Kenneally 8139*, 26.iv.1982, Gauging Stn, Camp Creek, c. 12 km SW of mining camp, Mitchell Plateau (PERTH, AD); *Kenneally 8193*, 1.v.1982, 21 km N of mining camp, Mitchell Plateau (PERTH); *Kenneally 8210*, 2.v.1982, Crusher Pool, Camp Ck, c. 6 km S of mining camp, Mitchell Plateau (PERTH); *Lullfitz 6051*, ix.1968, Kalumbuni on NE coast, WNW of Wyndham (PERTH).

## Non-Australian species *Hypoestes* examined

### 1. *H. decaisneana* Nees

JAVA: *Zollinger 428*, 1843, Java. (G: Herb. DC. on fiche AD, 2 specimens). *Bellanger s.n.*, ?1829, Java. [L. Bonton]. (G: Herb. DC. fiche AD).

2a. *H. laxiflora* Nees var.  $\beta$ 

JAVA: Zollinger 2286, 1846, Java. (G: Herb DC, fiche AD syntype).

2b. *H. laxiflora* Nees var.  $\alpha$ 

JAVA: Cuming 1019, 1841, Prov. Albay, Luzon, Philippines. (K: 2 syntype sheets).

3. *H. rosea* Decaisne: nom. illeg. (? = *H. decaisneana* Nees).

TIMOR: Riedle s.n., s. dat. (? 1801) Timor. (P: type sheet).

## 22. ISOGLOSSA Oersted

This genus has not been recorded for Australia before, but it is represented by a single species which had previously been described under *Justicia*, *J. eranthemoides* F. Muell. It became obvious at an early stage in this work that the species was most closely related to three species formerly treated in Malesia as the genus *Strophacanthus*.

This genus was first described by Lindau (1894a) when he referred to it as a new genus based on *Justicia collina* T. Anderson, and referred to a figure of its pollen. He later (Lindau 1895), published a description of the genus and added a further two species, *Strophacanthus dichotomus* (Bl.) Lindau based on *Justicia dichotoma* Bl. and *Strophacanthus terminalis* (Fawcett) Lindau based on *Dianthera terminalis* (Table 17). The genus was included under his subtribe Isoglossinae of tribe Isoglosseae.

The three species mentioned above were transferred by Moore (1922) to section *Euryantheae* of *Ptyssiglottis* T. Anderson, but Bremekamp (1948) reintroduced *Strophacanthus*, considering the two genera distinct by the "structure of the inflorescence, the pollen grains and the testa". Within this same publication he listed five species of *Strophacanthus* from India, Java, Celebes, Timor and the Moluccas and considered that some other species previously referred to *Ptyssiglottis* might also need to be transferred.

Hansen (1985) has transferred the species of *Strophacanthus* to a more widely circumscribed *Isoglossa* Oersted, a genus which had previously been considered to be entirely African and recognisable by its distinctive 2-porate and lens-shaped pollen. In expanding *Isoglossa* to include the south-east Asian species of *Strophacanthus*, Hansen also expands the allowable pollen types to include species with 3-colporate pollen. As discussed on p. 35, this expanded *Isoglossa* concept may impinge on the expanded *Justicia* s. lat. of Gibson (1973) and Graham (unpubl.).

Within his paper Hansen (l.c.) also reduced *Strophacanthus terminalis* (Fawcett) Bremek. of Timor to a synonym of the widespread *Isoglossa dichotoma* (Hassk.) B. Hansen. The Australian material resembles very closely specimens seen in G and L of *Isoglossa dichotoma* (labelled *Strophacanthus dichotomus*), but they have not been included under this species as they differ from it in their 3-colporate pollen (see Note 1) and possibly other characters not yet fully understood.

**Isoglossa** Oersted, Vidensk. Meddel. Dansk Naturhist Foren. Kobenhavn (1854) 155 nom. cons.; B. Hansen, Nord. J. Bot. 5 (1985) 5.

*Type species: I. ciliata* Oersted.

*Strophacanthus* Lindau, Bot. Jahrb. 18 (1894) 58 and in Engler & Prantl, Nat. Pflanzenfam. IV, 3b (1895) 344; Bremekamp, Verh. Kon. Nederl. Akad. Wetensch., Afd. Natuurk. 45 (1948) 43.

*Type species: S. collinus* (T. Anderson) Lindau (India).

? *Leda* C.B. Clarke, J. Asiat. Soc. Bengal 74 (1907) 690.



Publication	Species		
	<i>Justicia collina</i> T. Anderson (1867)	<i>J. dichotoma</i> Blume (1826)	<i>Dianthera terminalis</i> Fawcett in Forbes (1885)
Nees (1847a)		<i>Rhaphidospora</i> <i>dichotoma</i> ; <i>Leptostachya</i> <i>dichotoma</i> ; ? <i>Rhaphidospora</i> <i>tenella</i>	
Clarke (1885)	<i>Dianthera collina</i>	<i>Dianthera dichotoma</i>	
Lindau (1895)	<i>Strophacanthus</i> <i>collinus</i>	<i>Strophacanthus</i> <i>dichotomus</i>	<i>Strophacanthus</i> <i>terminalis</i>
Moore (1922)	<i>Ptyssiglottis</i> <i>collina</i>	<i>Ptyssiglottis</i> <i>dichotoma</i>	<i>Ptyssiglottis</i> <i>terminalis</i>
Bremekamp (1948)	<i>Strophacanthus</i> <i>collinus</i>	<i>Strophacanthus</i> <i>membranifolius</i> *	<i>Strophacanthus</i> <i>terminalis</i>
Hansen (1985)	<i>Isoglossa</i> <i>collina</i>	<i>Isoglossa</i> <i>dichotoma</i>	<i>Isoglossa dichotoma</i>

\*Basionym, *Rhaphidospora membranifolia* Miq., Fl. Ind. Bat. 2: (1857) 850. Bremekamp adopted 'membranifolia' as the epithet for the species since there had already been a *J. dichotoma* described in 1803 (= *Rhinacanthus nasutus* (L.) Lindau according to Bremekamp). However, Hansen (1985) showed that *Strophacanthus dichotomus* was based on *Peristrophe dichotomus* Hassk.

Table 17: Name changes associated with the three species originally attributed to *Strophacanthus* by Lindau (1895).

*Leptostachya* auct. non Nees: Nees in A. DC., Prodr. 11 (1847) 379, p.p. (as to *L. dichotoma*).

*Rhaphidospora* auct. non Nees: Nees in A. DC., Prodr. 11 (1847) 500, p.p. (as to *R. dichotoma* and *R. tenella*).

*Justicia* auct. non L.: T. Anderson, J. Linn. Soc., Bot. 9 (1867) 515, p.p. (as to *J. collina* and *J. dichotoma*).

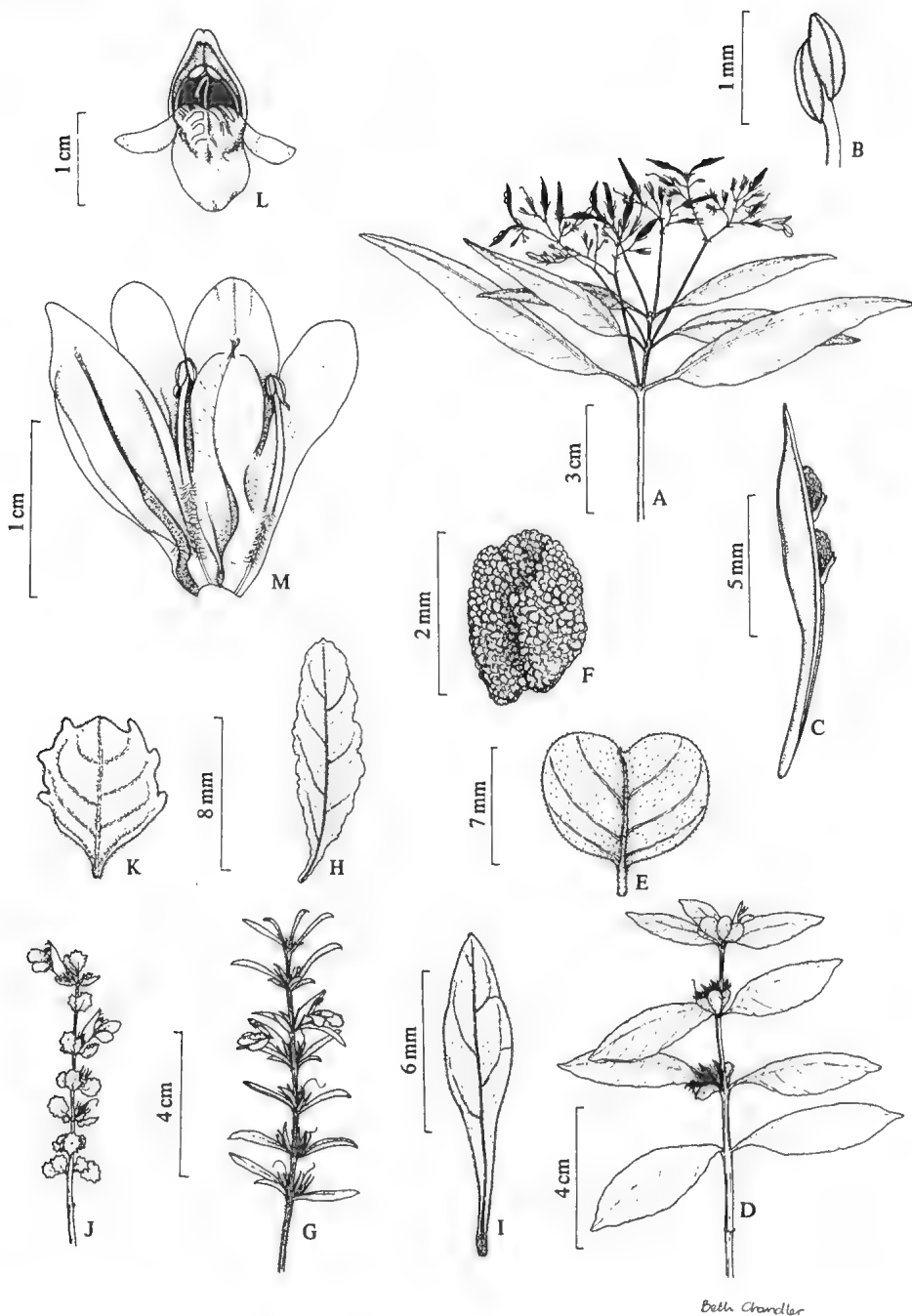
*Dianthera* auct. non L.: Clarke in Hook. f., Fl. Brit. India 4 (1885) 543, p.p. (as to *D. collina* and *D. dichotoma*).

*Ptyssiglottis* auct. non T. Anderson: S. Moore, J. Bot. 60 (1922) 355 (at least partly) with respect to Sect. *Euryantheae*.

Erect herbs or shrubs, with cystoliths. *Leaves* petiolate, ovate, opposite pairs connected by transverse ridge. *Inflorescence* long-pedunculate, often dichotomous, cymes combined into axillary or terminal panicles. *Bracts* and *bracteoles* small. *Calyx* segments 5, narrow, equal. *Corolla* tube widened distally; limb 2-lipped, upper lip notched, lower lip 3-lobed, with palate on middle lobe. *Stamens* 2; anthers with 2 cells inserted at different levels, without basal appendages; staminodes lacking. *Ovary* 2-celled, 2 superposed ovules per cell; stigma 2-lobed. *Capsule* club-shaped, seedless at base, 2 well-developed seed-bearing hooks in expanded part of each cell. *Seeds* 2 per cell, circular in outline, obliquely emarginate with short lateral projection at base, glabrous. Fig. 39 A-C.

### Distribution

Eight species of this genus are found in India, Asia and Malesia, with a further c. 50 species having been recorded from Africa. The only Australian species is represented by two collections from New South Wales and may possibly represent an early introduction of a Malesian species (see Note 1).



Beth Chandler

Fig. 39. A-C, *Isoglossa eranthemoides* (F. Muell.) R.M. Barker. A, habit; B, unequally inserted anther cells, without appendages; C, lateral view of half a capsule showing seed-bearing hooks subtending seed (*Moore 94*; holotype). D-F, *Calophanoides hygrophiloides* (F. Muell.) R.M. Barker. D, floral branch; E, bract; F, seed (*Andrews 103*). *Sarajusticia kempeana* (F. Muell.) Bremek. G-I, ssp. *muelleri* R.M. Barker. G, floral branch (*Setter 388*); H, leaf or bract (*Setter 388*); I, leaf or bract (*Gardner 2344*). J-M, ssp. *kempeana*. J, floral branch; K, leaf or bract; L, front view of flower; M, opened flower showing style channel of upper lip, palate of lower lip, stamens decurrent as hairy ridges (all R.M. Barker 140).

***Isoglossa eranthemoides* (F. Muell.) R.M. Barker, comb. nov.**

*Justicia eranthemoides* F. Muell., Fragm. Phyt. Austral. 6 (1867) 90 BASIONYM: Benth., Fl. Austral. 4 (1868) 551; F. Muell., Syst. Census Austral. Pl. (1882) 99; F. Muell., Sec. Syst. Census Austral. Pl. (1889) 167; F.M. Bailey, Qld Fl. 4 (1901) 1153; Jacobs & Pickard, Pl. N.S. Wales (1981) 61. — *Ecbolium eranthemoides* (F. Muell.) Kuntze, Rev. Gen. Pl. 2 (1891) 980.

*Holotype* (Fig. 39A): Moore 94, s. dat. Tweed River (MEL 601968).

Herb to 20 cm, or ? shrub; branches, petioles and sometimes underside of leaves pubescent; nodes swollen. *Leaves*, with petioles 5-15 mm long; blade ovate to ovate-lanceolate, 2-7 x 1-2 cm, base attenuate, somewhat asymmetrical, entire, apex acute; both surfaces with sparse, conical, eglandular hairs and linear cystoliths, upper surface darker green than lower, somewhat shiny. *Inflorescence* axillary or ? terminal, long-pedunculate dichotomous cymes combined into panicle, comprising normal and smaller, possibly cleistogamous flowers. *Peduncles* 1.2-3 cm long, eglandular hairy. *Bracts* triangular, c. 1 mm long, with only eglandular hairs towards base, mixed with glandular hairs towards apex. *Pedicels* c. 2-3 mm long, with mixture of eglandular and glandular hairs. *Calyx* segments linear, 3-5 mm long, with eglandular and glandular hairs. *Corolla* white, c. 12 mm long on upper side, externally with pubescence along veins of palate and middle lobe of lower lip, internally glabrous except for ring of hairs at base of filaments where they join corolla at top of tube; tube 2-2.5 mm long, widening into 3-3.5 mm long throat; upper lip notched, innermost in bud, ? porrect, narrower than lower, ? without style channel; lower lip 3-lobed, 2 lateral lobes narrower than middle lobe which has prominent palate. *Stamens* more or less included, anthers reaching base of corolla lip; filaments c. 2.5 mm long, glabrous or eglandular pubescent in basal half. *Disc* annular. *Ovary* ellipsoid, glabrous; style glabrous, 4-5 mm long, rarely (possible cleistogamous flower) c. 2 mm long, stigma expanded into flat, more or less circular, ? 2-lobed disc. *Capsule* either 5-7 mm long (? cleistogamous origin), or 9.5-12 mm long, glabrous. *Seeds* c. 1.5-2 mm, covered with more or less concentrically arranged broken ridges. Fig. 39 A-C.

***Distribution***

*I. eranthemoides* is known only by the type collection from Tweed River and one other recent collection from the Booyong Recreation Area, both localities in north-eastern New South Wales. Fig. 40.

***Ecology***

Nothing is known of this species, except that the Burgess collection is recorded from deep shade in an *Heritiera trifoliata* forest.

***Notes***

1. As already mentioned in the introduction to the genus *I. eranthemoides* appears to be very similar to *I. dichotoma* of Java. Hansen's (1985) description of the pollen of the latter as 2-porate 'Gürtelpollen' is however different from the pollen type of *I. eranthemoides* where it is 3-colporate 'Spangpollen' (pers. obs.) and similar to that illustrated by Hansen for *I. inermis* (R. Benoist) B. Hansen and *I. clemensorum* (R. Benoist) B. Hansen both, Vietnamese species. Nor does the anther cell arrangement of *I. eranthemoides* agree with that depicted for *I. dichotoma*; again it resembles more closely that depicted for the two Vietnamese species.

As there are only 2 known fragments of the Australian species, further collections, or at least observations, are desirable particularly with respect to its habitat, habit, corolla shape and presence or absence of markings or style channel.

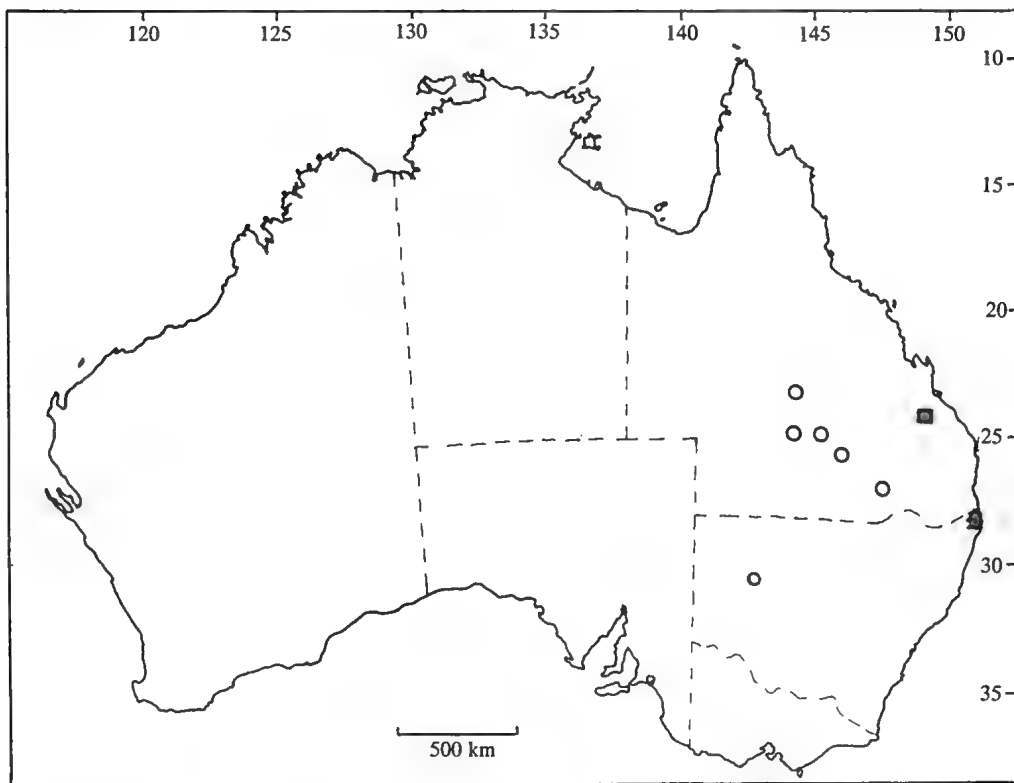


Fig. 40. Distribution of *Isoglossa* and *Rhaphidospora* in Australia (○ *R. bonneyana*; ■ *R. cavernarum*; ▲ *I. eranthemoides*).

2. The resemblance of this species to *Pseuderanthemum variabile* is quite striking in dried material, but in fresh material is presumably not so marked. The two are easily distinguished by their corollas (2-lipped with a palate in *Isoglossa* and more or less regular and without a palate in *Pseuderanthemum*) and their stamens (included under the upper lip, with distinctly unequally inserted anther cells and without staminodes in *Isoglossa* contrasting with exserted stamens, more or less equally inserted anthers cells and two staminodes in *Pseuderanthemum*).

Two specimens which have in the past been referred to *Justicia eranthemoides*, Guilfoyle MEL 100865 from Tweed and *White BRI 141175* from Canungra, bear a resemblance to the type, but seem to belong to *P. variabile*. Both specimens lack the glandular hairy rachises of *I. eranthemoides*, differ in leaf shape and the two flowers of the Guilfoyle specimen at least are almost certainly *Pseuderanthemum*. However, the White collection is not really adequate to determine its true identity and it could belong to either *Isoglossa*, *Pseuderanthemum*, or even *Rhaphidospora*, to which it also shows a resemblance in the vegetative parts.

### *Specimens examined*

NEW SOUTH WALES: *Burgess H 208*, 15.x.1976, Booyong Recreation area (NSW); *Moore 94*, s. dat. Tweed River (MEL 601968).

Specimens inadequate for final determination, but probably belonging to *Pseuderanthemum variabile* (see Note 2).

NEW SOUTH WALES: *Guilfoyle s.n.*, s. dat. Tweed (MEL 100865).

QUEENSLAND: *White s.n.*, v.1917, Canungra (BRI 141175).

## 23. RHAPHIDOSPORA Nees

Whether one treats *Rhaphidospora* as a section of *Justicia*, or as a distinct genus (see p. 34), there have been no species previously recorded for Australia. Two Australian species hitherto treated under *Justicia* are now considered to belong here. *Justicia cavernarum* F. Muell. was described in 1867 by Mueller without consideration of its position in this genus, while Bentham (1868) commented that the fragments seen "closely resemble the pubescent variety of the E. Indian *J. glabra* Koen. [*Rhaphidospora glabra* Nees], but are not in a state to determine whether they really belong or not to that species". Though there are no further collections available since that time, Bentham was obviously correct in his association of *J. cavernarum* with *Rhaphidospora* and the new combination is made here. The most important diagnostic characters for *Rhaphidospora* are the presence of conical spines on the seed-coat and the cluster of 1-5 flowers on the ends of long, sometimes dichotomous, peduncles. *R. cavernarum* may well prove to be conspecific with other Malesian or even Indian species of *Rhaphidospora*, but more material is needed from Australia to establish all of its characters.

*Justicia bonneyana*, described by Mueller in 1882 (Mueller 1882d) and also relatively poorly represented in Australian herbaria, also belongs here. It has the characteristic inflorescence and seeds which show the conical excrescences on their coat (Fig. 35).

**Rhaphidospora** Nees in Wall., Pl. Asiat. Rar. 3 (1832) 115; Nees in A. DC., Prodr. 11 (1847) 499; Lindau in Engler & Prantl, Nat. Pflanzenfam. IV, 3b (1895) 329; Bremek., Verh. Kon. Nederl. Akad. Wetensch., Afd. Natuurk., 45 (1948) 47. — *Justicia* Sect. *Rhaphidospora* Benth. & Hook. f., Gen. Pl. 2 (1876) 1110; Clarke in Hook. f., Fl. Brit. India 4 (1885) 535.

*Type species: R. glabra* (J. Koenig ex Roxb.) Nees (India).

Herbs or shrubs, with cystoliths, sometimes (in Australia) with short, decussately arranged,

sometimes spinescent, branchlets along main axes. *Leaves* either petiolate, ovate, each opposite pair connected by transverse ridge, or (*R. bonneyana*) sessile, small, in axillary clusters by reduction of lateral branchlets. *Inflorescences* of 1-5-flowered clusters, usually with 1 flower mature at a time, borne at extremities of long axillary, often dichotomous peduncles. *Bracts* and *bracteoles* 2, small. *Calyx* segments 5, equal. *Corolla* small; tube widened distally, with 2 longitudinal folds behind; limb 2-lipped, upper lip erect, shallowly notched, lower lip recurved, 3-lobed, with palate on middle lobe. *Stamens* 2, exerted from throat; filaments glabrous; anthers 2-celled, cells inserted at different levels, lower with a white basal appendage; staminodes lacking. *Ovary* 2-celled, 2 superposed ovules per cell; stigma notched. *Capsule* club-shaped, seedless at base, 2 well developed seed-bearing hooks in expanded part of each cell. *Seeds* 2 per cell, discoid, glabrous, conical excrescences all over (i.e. muricate). Fig. 35 G-J.

### Distribution

It is difficult to give an accurate number of species within *Rhaphidospora* due to confusion in its interpretation and circumscription of species. For example, the type species, *R. glabra* from India, is also reputed to be in tropical West Africa where Clarke (1900) treated it as *J. glabra* in subgen. *Gendarussa*. Earlier Clarke (1885) had treated it as *J. glabra* of Sect. *Rhaphidospora*. Bremekamp (1948) considered that it was probably confined to India and Ceylon. At the present time there are 2-4 species of *Rhaphidospora* recognised from Malesia. *R. glabra* was listed by Lindau (1894) from New Guinea and *R. platyphylla* has also been described from there (Bremekamp 1957). The genus probably consists of approximately 10 species, but investigations need to be made within *Justicia* before the true number can be clarified. In Australia there are two species, both of which have previously been described under *Justicia*.

### Key to species of *Rhaphidospora* in Australia

- 1a. Leaves petiolate, ovate, 9-30 x 5-20 mm, crenulate. Peduncle with glandular hairs. Herb, without spines ..... 1. *R. cavernarum*
- 1b. Leaves sessile, narrow-elliptic, 2-8 x 0.5-1 mm, entire on margin. Peduncle without glandular hairs. Spiny divaricating shrub ..... 2. *R. bonneyana*

### 1. *Rhaphidospora cavernarum* (F. Muell.) R.M. Barker, comb. nov.

*Justicia cavernarum* F. Muell., Fragm. Phyt. Austral. 6 (1867) 91, BASIONYM; Benth., Fl. Austral. 4 (1868) 550; F. Muell., Syst. Census Austral. Pl. (1882) 99; F.M. Bailey, Syn. Qld Fl. (1883) 369; F. Muell., Sec. Syst. Census Austral. Pl. (1889) 168; F.M. Bailey, Cat. Pl. Qld (1890) 35; F.M. Bailey, Qld Fl. 4: (1901) 1152; F.M. Bailey, Compr. Cat. Qld Pl. (1913); Domin, Biblioth. Bot. 89 (1929) 606. — *Ecbolium cavernarum* (F. Muell.) Kuntze, Rev. Gen. Pl. 2 (1891) 980.

*Holotype*: Thozet 485, s. dat. Caves Mountain, Rockhampton (MEL 601967).

Decumbent ?herb, height unknown, with eglandular hairy branches, not spinescent. *Leaves* with petioles 5-10 mm long; blade ovate, 9-30 x 5-20 mm, eglandular hairy on both surfaces. *Inflorescence* of 2-3 flowers at end of axillary peduncles which exceed leaves; peduncles with mixed long glandular hairs and short eglandular hairs. *Bracts* and *bracteoles* c. 1-2 mm long, indumentum similar to peduncle. *Pedicel* c. 0.5 mm long. *Calyx* segments linear, c. 3-4 mm long, similar indumentum to peduncle. *Corolla* colour unknown, externally covered densely with eglandular hairs; tube c. 2 mm long, ciliate behind palate and at base of each filament, ?glabrous elsewhere, style channel ? absent; upper lip 2 mm long, ?notched; lower lip 2 mm

long. *Stamens* with filaments c. 1-1.5 mm long; anther cells c. 0.7 mm long, hairy on backs, appendage on lower cell c. 0.4 mm long. *Disc* cup-shaped with irregular margin. *Ovary* ? glabrous; style c. 5 mm long, ?pubescent at base, glabrous distally. *Capsule* c. 1.8 cm long, covered with eglandular hairs. Seeds sharply tuberculate on margin, tubercles apparently not barbed. Fig. 35 G.

### Distribution

*R. cavernarum* is known only by two collection, one from Caves Mountain near Rockhampton and the other from Cape Yorke Peninsula.

### Ecology

Apart from the fact that the type of the species was growing in mountain caves with a narrow-elongated leafed variety of *Ophioglossum vulgatum* (Mueller 1867), nothing is known of this species.

### Note

This species could be conspecific with a Malesian *Rhaphidospora* species, but these are insufficiently known at this stage. Further collections from Australia are necessary to more adequately describe *R. cavernarum*. A comparison of the Australian material with that held in K of *R. glabra* Koenig ex Roxb. reveals that the two are very similar as stated by Bentham (1868). At this stage they are separable on leaf size and pubescence characters which probably indicate an infraspecific rather than a specific difference. However, they also differ in seed characters in that the tubercles of the seed in *R. glabra* are themselves barbed, whereas these barbs are absent in *R. cavernarum*. They possibly differ as well in distribution of hairs within the corolla tube and throat, but further floral material is required to clarify this.

### Specimens examined

QUEENSLAND: *Hann* 356, xii.1873, Cape Yorke Peninsula (K); *Thozet* 485, s. dat., Caves Mountain, Rockhampton (MEL: holotype).

## 2. *Rhaphidospora bonneyana* (F. Muell.) R.M. Barker, comb. nov.

*Chloanthes bonneyana* F. Muell., *Fragm. Phyt. Austral.* 10 (1876) 73, BASIONYM; Munir, J. Adelaide Bot. Gard. 1 (1977) 86. — *Hemistemon bonneyi* F. Muell., *Fragm. Phyt. Austral.* 10 (1876) 73, pro syn.

*Holotype*: *Bonney* 2, s. dat. Trans fl. Darlingi. Beyond Mt Murchison (MEL 69138).

*Justicia bonneyana* F. Muell., *Wing's Southern Science Rec.* 2 (1882) 74; F. Muell., *Syst. Census Austral. Pl.* (1882) 99; F. Muell., *Sec. Syst. Census Austral. Pl.* (1889) 167; Moore, *Handbk. Fl. N.S. Wales* (1893) 346; W.R. Barker in Jessop (ed.) *Fl. Central Austral.* (1981) 336. — *Ecboium bonneyanum* (F. Muell.) O. Kuntze, *Rev. Gen. Pl.* 2 (1891) 980. — *Justicia procumbens* L. var. *bonneyana* (F. Muell.) Domin, *Biblioth. Bot.* 89 (1929) 604.

*Lectotype* here designated: *Bonney* s.n., 1879, near Mt Murchison (MEL 86988); *isolectotype*: (NSW 151899).

Glabrous or hairy, divaricating shrub, to 40 cm high, with decussate, spinescent, lateral branchlets. *Leaves* more or less sessile, very small, linear-elliptic, 2-8 x 0.5-1 mm, entire, eglandular hairy, often in small clusters along older stems. *Inflorescence* of 1-5 clustered flowers (usually 1 mature at a time) at end of long, often dichotomous, axillary peduncles. *Peduncles* more or less glabrous, becoming spinescent with age. *Bracts* 0.5-1 mm long, triangular, glabrous or with glandular and eglandular hairs. *Bracteoles* 1 mm long, linear-lanceolate, with glandular and eglandular hairs. *Pedicel* to 3 mm long. *Calyx* with linear-

lanceolate, equal lobes 2 mm long, with glandular hairs all over, or with eglandular hairs and shorter glandular puberulence. *Corolla* pale lilac or white with deep red spots in mouth of lower lip, externally pubescent; tube 7 mm long, densely ciliate along folds behind palate of lower lip, tufts of hairs at base of each filament, 2 V-shaped patches of hairs at apex of tube, one line of each of these patches forming ciliate style channel of upper lip; upper lip notched, 2 mm long, lower lip obovate with lateral lobes oblong, 3.5 mm long; *Stamens* with filaments 2.5 mm long; upper anther cell 0.9 mm long, lower 1.0 mm long, with basal white appendage 0.5 mm long; backs of anther cells, particularly upper one, hairy. *Disc* cup-shaped, margin irregular. *Ovary* ellipsoid, hairy or glabrous in upper part; style thick, pubescent in lower half; stigma notched. *Capsules* 1.6 cm long, glandular and eglandular hairs all over. *Seeds* sharply tuberculate on margin, tubercles sometimes sparsely barbed. Fig. 35 H-J.

### Typification

*Justicia bonneyana* F. Muell.

Mueller obviously asked Bonney for more material of the species *Chloanthes bonneyana* which he had described in Verbenaceae in 1876. The Bonney specimen in MEL which was collected in 1879 (annotated as *Justicia bonneyana*) has attached to it a note, presumably from Bonney, which reads 'Like a cotton bush grown in gully of ranges — specimens sent some time back. You asked for flower and fruit of it'. As well as this note there is a small fragment of the plant together with a mature capsule and seed and Mueller's handwritten description in Latin as well as his handwritten English description which was published in *Southern Science Record*. Mueller must have forgotten he had previously published the species under a separate family; there is no doubt that *Justicia bonneyana* and *Chloanthes bonneyana* are only taxonomic synonyms.

### Distribution

Only nine collections were seen, the majority of these from south-western Queensland with two from far north-western New South Wales. Fig. 40.

### Ecology

*R. bonneyana* is an apparently rare species found growing in gullies or on the tops of rocky mesas in the ranges of south-western Queensland and northwestern New South Wales. It has been found associated with Wilga (*Geijera parviflora*), and Purdie 2070 was from "Acacia catenulata tall open shrubland with scattered emergent *Eucalyptus thozetiana* trees". Flowering is probably in response to good rainfall as specimens have been collected between March and October.

### Notes

1. The Queensland and New South Wales specimens are possibly separable as different varieties or forms, but because of the paucity of collections the complete variability of the species is not known. On the material available, two groups can be recognized with the following characters.

(a) Calyx with large-topped glandular hairs. Corolla with sparse cover of eglandular hairs in bud. Branches glabrous or very sparsely pubescent. . . . Queensland specimens.

(b) Calyx with eglandular hairs plus shorter glandular puberulence. Corolla with extremely dense cover of eglandular hairs in bud. Branches pubescent in all parts. . . . New South Wales specimens.

2. Having described both *Chloanthes bonneyana* and *Justicia bonneyana*, Mueller



presumably realised that the two were the same as apart from his initial description of *Chloanthes bonneyana* there is no further reference to the species in his work. In both Systematic Censuses (Mueller 1882, 1889), *Justicia bonneyana* is listed, but there is no mention of *Chloanthes bonneyana*. A similar situation has arisen with *Strobilanthes tatei* F. Muell. and *Clerodendrum holtzei* F. Muell., but in this case the taxa belong in Verbenaceae (see p. 281).

### *Specimens examined*

NEW SOUTH WALES: *Bonney s.n.*, 1879, near Mt Murchison (MEL 86988: lectotype of *J. bonneyana*, NSW 151899); *Bonney 2*, s. dat. beyond Mt Murchison (MEL 69138, holotype of *Chloanthes bonneyana*).

QUEENSLAND: *W.R. Barker 4789 & Chinnock*, 23.ix.1984, Unnamed range S of Gowan Range, c. 6 km direct WNW of 'Listowel Valley', c. 2 km W of Blackall-Adavale Rd (AD); *Chinnock per W.R. Barker 4790*, 23.ix.1984, as for *Barker 4789* (AD); *Everist 1870*, viii.1939, Lorne Peak, c. 50 m SSW of Blackall (BRI, MEL); *Everist 3798*, 27.v.1949, Biddenham, c. 10 m W of Augathella (BRI); *Gordon 148*, iii.1950, Morven Range (BRI, 2 sheets, only 1 seen); *Gordon 9130A*, 28.i.1984, Thomby Range (AD); *Purdie 2070*, 8.iv.1984, Gowan Range, about 20 km approx. NNW of "Idalia" homestead (CBG).

## 24. CALOPHANOIDES (Clarke) Ridley

The only Australian species of this genus was first described by Mueller in 1867 as *Justicia hygrophiloides*. He referred it to sect. *Adhatoda* of *Justicia*, but it was subsequently referred by Lindau (1895) to sect. *Tyloglossa* of *Justicia*. This latter section was distinguished by its tightly crowded flowers in diminished inflorescences in the leaf axils as opposed to the 1-2 pedunculate, axillary flowers in his sect. *Adhatoda*. No further attempt has been made to determine the true position of *Justicia hygrophiloides*, apart from Bremekamp's (1962) assertion that it probably represented a new genus. In order to clarify its position, it proved necessary to investigate the status of Lindau's sect. *Tyloglossa* and the genus *Calophanoides* to which it might also be referred.

Sect. *Tyloglossa* was based on the genus *Tyloglossa*, first described by Hochstetter in 1843 and consisting of six African species (Table 18). Subsequently Nees von Esenbeck (1847b) added six further species from Brazil, but then in a publication, presumably prepared later (Nees 1847a), he reduced *Tyloglossa* to a section of *Adhatoda*, describing 78 species in total from Africa, America and Asia.

Clarke (1885) described a new section of *Justicia* called *Calophanoides* which consisted of Indian species with solitary or clustered axillary flowers. Included in his sect. *Calophanoides* were three species (*J. quadrifaria*, *J. neesiana* and *J. zollingeriana*) which had already been included under section *Tyloglossa* of *Adhatoda* by Nees (1847a). Because three of the species involved had already been listed under sect. *Tyloglossa* this raised the possibility that *Calophanoides* was synonymous with *Tyloglossa*, whether considered at the generic or sectional rank.

Reference to the original description of the genus *Tyloglossa* by Hochstetter (1843) reveals that he described the inflorescences of his six species as terminal spikes (Table 18). However, in two of the six species the inflorescences were not described and these two were later designated by Clarke (1900) as having sessile and axillary clusters; Clarke placed these two species under his sect. *Calophanoides*. Since the real circumscription of *Tyloglossa* depends on lectotypification and Hochstetter (1843) described the inflorescence as a terminal spike, the type species would have to come from within the four species now referred (Heine 1963) to *Justicia flava* (Table 19) and presumably belonging to the segregate genus *Rostellularia*. Thus *Calophanoides* and *Tyloglossa* cannot be considered as synonymous.

Hochstetter 1843		Clarke 1900		Heine 1963
Accepted name	Inflorescence	Accepted name	Inflorescence	Accepted name
<i>Tyloglossa</i>		<i>Justicia</i> sect. <i>Rostellularia</i>		<i>Justicia</i>
<i>T. palustris</i>	terminal spike	<i>J. palustris</i>	terminal spike	{ All 4 species as <i>J. flava</i>
<i>T. acuminata</i>	terminal spike	<i>J. palustris</i>	terminal spike	
<i>T. major</i>	terminal spike	<i>J. flava</i>	terminal spike	
<i>T. minor</i>	terminal spike	<i>J. flava</i> sect. <i>Calophanoides</i>	terminal spike	
<i>T. kotschyi</i>	undescribed	<i>J. sexangularis</i>	sessile, axillary cluster	{ both species under <i>J. insularis</i>
<i>T. schimperi</i>	undescribed	<i>J. calcarata</i>	sessile, axillary cluster	

Table 18: Taxonomic history of the six species included under *Tyloglossa* Hochstetter in the original publication of that genus, together with the inflorescence type attributed to them.

Ridley (1923) raised Clarke's sect. *Calophanoides* to generic level, but his circumscription was narrower than that of Clarke. In his 1907 treatment of *Justicia*, Clarke recognised six species from the Malay Peninsula under sect. *Calophanoides* (these were in addition to species he had already described under sect. *Calophanoides* from India (Clarke 1885) and Africa (Clarke 1900). Ridley (l.c.) accepted only one of these, *J. quadrifaria*, in the genus *Calophanoides*, which he attributed to himself. Bremekamp (1948) described *Calophanoides* in the same sense as Ridley, supplying an expanded generic description and listing three species for the genus. The Australian material seems to fit here although the large, heart-shaped bracts are in contradiction to Bremekamp and Ridley's descriptions of the bracts as small or lacking. However, Clarke's original description (1885), at least of the type species *J. quadrifaria*, refers to the bracts as "spathulate, orbicular or emarginate". Thus there must be some doubt cast on whether Ridley's *Calophanoides quadrifaria* from the Malay Peninsula is in fact conspecific with the Indian *Justicia quadrifaria* of Clarke's 1885 work. As it was Clarke (1907) who first described the Malay material as *J. quadrifaria* it seems likely that the two are the same, particularly as he describes the bracts as "spathulate, rusty-pubescent, occasionally present". This agrees with his description of the Indian material and the implication that the bracts are frequently absent may account for Ridley and Bremekamp's subsequent descriptions. It should be noted that Hsieh and Huang's (1978) description of the bracts of *J. quadrifaria* from Taiwan refers to them as "spathulate and about 10 mm long". The bract character of *Calophanoides* is in need of clarification. Apart from the bract difference, Australian material agrees well with the generic descriptions of *Calophanoides*, but the group is in need of revision.

**Calophanoides** (Clarke) Ridley, Fl. Malay Penins. 2 (1923) 592; Bremek., Verh. Kon. Nederl. Akad. Wetensch., Afd. Natuurk. 45 (1948) 56. — *Justicia* L. sect. *Calophanoides* Clarke in Hook. f., Fl. Brit. India 4 (1885) 530 p.p. (only as to species 20-23); Clarke, J. Asiat. Soc. Bengal 74 (1907) 681 p.p. (excluding anisophyllous species numbered 9-12) — *Justicia* L. sect. *Tyloglossa* Hochst.: Lindau in Engler & Prantl, Nat. Pflanzenfam. IV, 3b (1895) 349 p.p. at least with respect to *J. quadrifaria*, *J. zollingeriana* and *J. hygrophiloides*: see Introduction.

*Type species*: *C. quadrifaria* (Nees) Ridley (Malay Peninsula, India): see Typification.

Erect herbs or shrubs, with cystoliths, constriction above each node. *Leaves* petiolate, opposite pairs connected by transverse ridges at nodes, elliptic. *Inflorescence* sessile, axillary, solitary or few-flowered cymes. *Bracts* 2, small and inconspicuous, or (in Australia) conspicuous and obcordate. *Bracteoles* small or lacking. *Calyx* segments narrow, equal, acute.

*Corolla* with short tube widened apically; limb 2-lipped, upper lip triangular, notched, ciliate style channel, lower lip 3-lobed, palate on middle lobe. *Stamens* 2, inserted at top of tube; filaments glabrous except where attached basally to tube; anthers 2-celled, cells inserted at different levels, lower cell with white basal appendage; staminodes lacking. *Ovary* 2-celled, 2 superposed ovules per cell; style glabrous or pubescent; stigma slightly notched. *Capsule* clavate, with short seedless base, 2 well-developed seed-bearing hooks in expanded portion of each valve. *Seeds* more or less discoid, smooth-tuberculate all over. Fig. 39 D-F.

### Typification

Ridley (1923) attributed *Calophanoides* to himself, even though it is clearly based on Clarke's *Justicia* sect. *Calophanoides* which seems to have been first published in 1885. The only species described by Ridley (l.c.) in raising sect. *Calophanoides* to generic level was *C. quadrifaria*. This species was listed in Wallich's catalogue (number 2479) as *Justicia quadrifaria*, but was not validly published until 1832 when Nees described it as *Gendarussa quadrifaria*. This particular species has been listed as the type of the genus in 'Index Nominorum Genericorum' by Bremekamp (1979) and was presumably nominated because it was the only species which Ridley described, Bremekamp having also attributed the genus *Calophanoides* to Ridley.

Because the genus *Calophanoides* is clearly based on Clark's section of *Justicia*, the selection of a type should have been based on the seven species described by him in 1885. As this includes *Justicia quadrifaria*, the choice by Bremekamp (l.c.) maintains current concepts of the genus.

### Distribution

The taxonomic and geographical circumscription of *Calophanoides* is indeterminable at present. It seems to consist of 5-10 species from India, China, Malaysia, the Philippines, Java and probably New Guinea. The position of the African complex *J. insularis* T. Anderson and the ten species from South Africa assigned by Clarke (1900, 1901 respectively) to *Justicia* sect. *Calophanoides* is unknown.

### *Calophanoides hygrophiloides* (F. Muell.) R.M. Barker, comb. nov.

*Justicia hygrophiloides* F. Muell., Fragm. Phyt. Austral. 6 (1867) 89, BASIONYM; Benth., Fl. Austral. 4 (1868) 550; F. Muell., Syst. Census Austral. Pl. (1882) 99; F. Muell., Sec. Syst. Census Austral. Pl. (1889) 167; Lindau in Engler & Prantl, Nat. Pflanzenfam. IV, 3b (1895) 349; F.M. Bailey, Qld Fl. 4 (1901) 1151; F.M. Bailey, Compr. Cat. Qld Pl. (1913) 375, f. 351; Jacobs & Pickard, Pl. N.S. Wales (1981) 6l. — *Ecbolium hygrophiloides* (F. Muell.) Kuntze, Rev. Gen. Pl. 2 (1891) 980.

*Lectotype here designated: Dallachy s.n.*, 3.v.1865, Top of Coast Range, Rockingham Bay (MEL 601975); *other syntypes: Dallachy 313*, 7.ii.1863, *Dallachy 382*, 23.ii.1863, Rockhampton (both on MEL 601969); *Dallachy 313*, 8.vii.1867, *Dallachy s.n.*, 9.iv., Port Denison (both on MEL 601973); *Dallachy s.n.*, 1.viii.1867, Coast Range (MEL 601974); *Dallachy s.n.*, vii.1867, Rockingham Bay (MEL 601972); *Hill s.n.*, s. dat. Brisbane River (K); *Hill & [Mueller] s.n.*, s. dat. Moreton Bay (MEL 601985); *P. O'Shanesy 134*, 20.viii.1867, Rockhampton (MEL); *P. O'Shanesy 168*, 6.vi.1867, Rockhampton (MEL); *Possible syntypes: Anon s.n.*, s. dat. Rockhampton (MEL 100878); *Anon s.n.*, s. dat. Moreton Bay (MEL 100869); *Anon s.n.*, s. dat. Port Denison (MEL 100871); *Anon s.n.*, s. dat. Rockingham Bay (K); *Anon. [Stuart] 324*, 53, December, without locality (MEL 100867); *Fitzalan s.n.*, s. dat. Port Denison (K p.p.); *Fitzalan s.n.*, s. dat. Port Denison (MEL 100873, MEL 100874); *Thozet 19*, s. dat. Rockhampton (MEL); *Thozet 228*, s. dat. Rockhampton (MEL).

Glabrescent shrub to 1 m tall. *Branches* 4-6-angled, sometimes 2-furrowed, usually with 2 longitudinal rows of hairs in furrows, or hairs all over. *Leaves* with petioles 2-6 mm long; blade elliptic, largest leaves 2.7-11.5 x 1.0-3.0 cm, glabrous or minutely hairy, base attenuate, entire or undulate, apex acute or acuminate, upper surface often drying dark green to black, dense cystoliths sometimes drying black and venation obscure, lower surface paler with venation obvious. *Inflorescence* of more or less sessile clusters composed of 2 or 4 obcordate bracts per axil, each bract pair subtending dense group of 3-5 flowers at differing levels of maturity. *Bracts* obcordate, 5-9 x 10-15 mm, shortly and sparsely eglandular hairy. *Bracteoles* 2, minute, triangular, 0.5 mm long; pedicel 1 mm long. *Calyx* segments linear-lanceolate, glabrous, 8.5-10 mm long, with conspicuous cystoliths. *Corolla* white, or ? yellow, with purple markings, externally glabrous; tube c. 7 mm long; upper lip c. 5.5 mm long, shortly 2-lobed, with ciliate style channel; lower lip with lobes c. 6.5 mm long, glabrous palate, ciliate at base of folds behind palate and at base of each filament inside tube. *Stamens* exserted; filaments c. 6 mm long, flattened; upper anther cell usually hairy on back, sometimes with a short, 0.1 mm long basal spur, lower cell glabrous except sometimes for few hairs on back of cell and its junction with 0.6 mm long white spur at base. *Ovary* ellipsoid, glabrous; style hairy, particularly in lower half, thick; stigma slightly notched at apex. *Disc* annular with undulate rim. *Capsule* ellipsoid with acute apex, 8-10.5 mm long, glabrous, usually 4-seeded, sometimes reduced to 1-2-seeded. *Seeds* 2 x 1.7 mm, pale yellow initially, dark brown later. Fig. 39 D-F.

### Typification

Mueller's original description of *Justicia hygrophiloides* contains only "per silvas Australiae orientalis a fluvio Clarence's River usque ad promontorium Cape York" as an indication of the location of the collections he had seen. Such a broad sweep means that any collection made before or during 1867 and which can be shown to have been seen by Mueller becomes eligible for lectotypification. Within MEL there are a number of such collections, with a further three in K. Some of the collections which are eligible were made during 1867, in the months April to August, but as the fascicle containing the description is dated December 1867, it seems probable that Mueller did see them before publication.

There is another group of specimens which are annotated '*Justicia hygrophiloides*' in Mueller's hand, but these lack dates and hence can only be regarded as possible syntypes.

The collection *Hill and Mueller MEL 601985* from Moreton Bay bears the inscription "Adhatoda! hygrophiloides n. sp. ? Dr [Sonder] will greatly oblige Dr Mueller with his opinion on this plant". The duplicate collection in K is also labelled "Adhatoda hygrophiloides". Both of these specimens must have been studied by Mueller and would seem ideal for selection as lectotype, but there is better material available. *Dallachy MEL 601975* collected on 3.v.1865 bears the annotation "*Justicia hygrophiloides* (Adhatoda) F.M." and consists of three fragments with numerous flowers, capsules and seeds, while the Hill collection lacks capsules and seed. For this reason the Dallachy collection has been selected as lectotype.

### Distribution

*C. hygrophiloides* is found within the rainforests of the east coast of Queensland, with two records extending into northern New South Wales (Fig. 41). The species possibly extends into Papua New Guinea as material of the later described *J. chalmersii* Lindau seen in K appears very similar.

### Ecology

*C. hygrophiloides* is recorded as occurring as an understorey shrub in rainforest (often dry), within vine forest or in the ecotone between *Eucalyptus* woodland and closed forest with *Araucaria cunninghamii*, in clay loam, sandstone, and stony soils derived from basic igneous rocks, at 550-800 m altitude. Flowering appears to be year round.

### Note

The endemic, Australian species *Sarojusticia kempeana* appears to be related to *Calophanoides hygrophiloides* and it may prove necessary to transfer one of the species involved to the other genus after further investigations of their relationships. (See Note 3 after *Sarojusticia kempeana*). The direction of any transfer, should it prove to be necessary, can only be assessed after a revision of *Calophanoides* and an assessment of the position of *C. hygrophiloides* within it. Should it need to be excluded, then *Sarojusticia* should be investigated as an alternative placement of the species.

### Representative specimens examined (65 specimens seen)

NEW SOUTH WALES: *Clark, Pickard & Coveny* 1312, 20.vi.1969, Brunswick Heads (BRI, NSW); *Floyd* 274, 23.ii.1977, Horton's Creek (CANB).

QUEENSLAND: *Andrews & Simon* 103, 7.v.1975, Cedar Ck Falls near Conway on banks of Creek (BRI, CANB); *Brass* 2439, 9.iv.1932, Slopes of Mt Frazer (BRI, K); *Bailey s.n.*, vii.1874 and vi.1875, 3 m Bush (Newmarket-Brisbane) (BRI); *Dallachy s.n.*, 3.v.1865, Top of Coast Range (Rockingham Bay) (MEL 601975); *Dietrich* 1962, iii.1865, Rockhampton (MEL, CANB); *Dixon s.n.*, 1899, Cairns (NSW 151902); *Gray* 1300, 1.iii.1979, S.F.R. 143, Windmill L.A. (AD); *Hartmann* 492, 1875, Condamine (MEL, BRI); *Hyland* 5954, 6.iv.1972, S.F.R. 607, Bridle L.A. (QRS: 2 sheets); *Jones s.n.*, v.1962, Shute Bay (BRI 033097); *McDonald* 3193, *Fisher & Ryan*, 15.iv.1980, Bulburin State Forest, Cabbage Tree Road, between Wompoo and Warrigal Logging areas (BRI); *Michael* 2231, 14.vii.1935, Little Mt Alford (BRI); *Olsen* 3532 & *Byrnes*, 24.v.1977, Cania Gorge (BRI); *Sharpe* 1610, 11.viii.1975, Hinchinbrook Island, Little Ramsay Bay (BRI); *Smith* 3919, viii.1948, North of Mt Molloy, in rainforest (BRI); *Smith & Webb* 3139, 4.vi.1947, near Imbil (CANB, BRI); *Telford* 8758, 25.vi.1982, Little Crystal Ck, Paluma Range (AD,

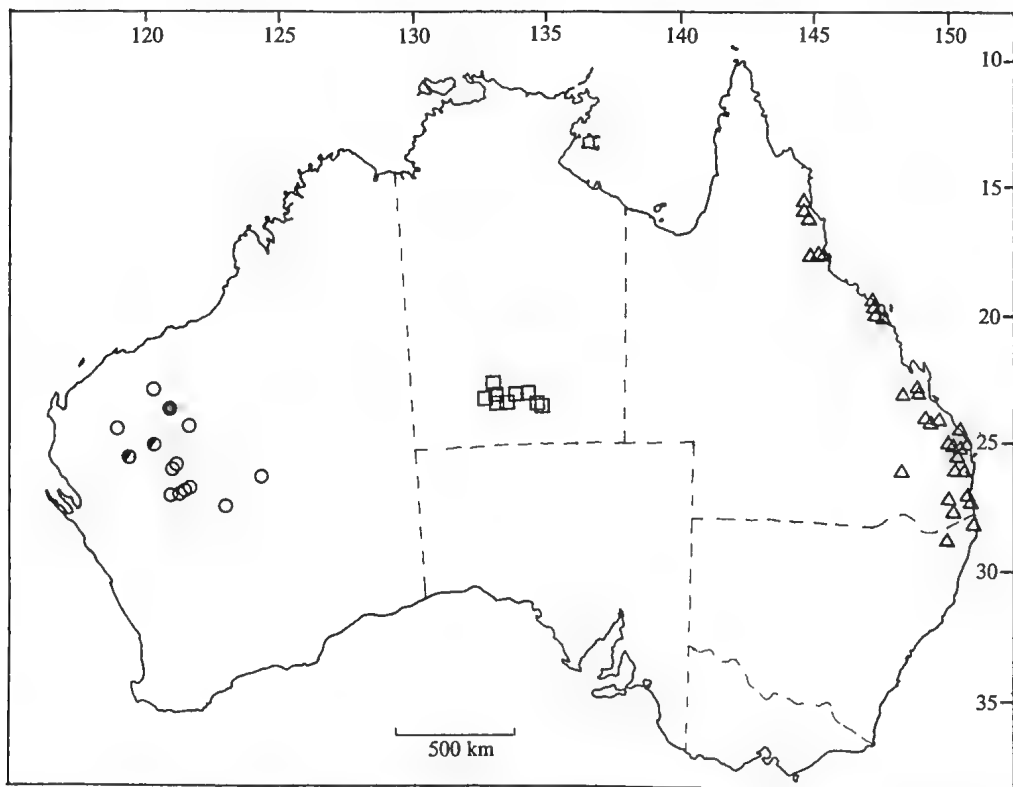


Fig. 41. Distribution of *Sarojusticia* and *Calophanoides* in Australia (□ *S. kempeana* ssp. *kempeana*; ○ *S. kempeana* ssp. *muelleri*; ● *S. kempeana* ssp. *muelleri* with glabrous capsules; ● aff. *S. kempeana* ssp. *muelleri*; △ *C. hygrophiloides*).

CBG); *Thorsborne & Travers* 446, 4.vi.1978, S.F.R. 461 Stony Creek, c. 3 km S of Cardwell (BRI); *Webb & Tracey* 7875, 25.v.1965, Mt Dryander, NE of Proserpine (BRI); *Webb & Tracey* 10460, 112.v.1971, Rundle Range State Forest, c. 10 m SE of Port Alma near O'Connor Ck which joins Fitzroy R near its mouth (BRI); *White s.n.*, v.1921, Fraser Island (BRI 142213); *White* 3526, 21.vi.1927, Mt Bauple (BRI); *White* 8144, 23.ix.1931, Byfield, near Keppel Bay (BRI); *White* 10798, iv.1937, Dawes Range (BRI); *Wilson & Puttock* UNSW 13285, 12.iv.1982, NW branch of Dryander Creek, Mt Dryander, near Proserpine (UNSW); *Young* 220 & *Randall*, 23.vi.1979, Top of Woowoonga Range, approx. 15 km NE of Biggenden (BRI).

## 25. SAROJUSTICIA Bremekamp

The endemic Australian genus, *Sarojusticia*, was first described by Bremekamp (1962), based on a species which had previously been referred to *Justicia*. It is possible that the genus may prove to be superfluous and that the species presently referred to it may be better treated under the same genus as the Australian species, *Calophanoides hygrophiloides*. For a discussion of this see Note 1 after the species.

*Sarojusticia* Bremek., Acta Bot. Neerl. 11 (1962) 195; W.R. Barker in Jessop, Fl. Central Austral. (1981) 337.

*Type species*: *S. kempeana* (F. Muell.) Bremek. ex Eichler (Australia).

Small woody subshrubs, with cystoliths and pubescent, striated branches. *Leaves* subsessile or shortly petiolate, abscission line near base of petiole, small, toothed, irregular or entire, opposite leaf pairs connected by transverse ridge. *Inflorescence* loose terminal or lateral spikes or solitary, subsessile flowers in axils of leaf-like bracts. *Bracteoles* 2, of similar shape but smaller than leaves and bracts. *Calyx* segments 5, more or less equal, free almost to base, hyaline along margin. *Corolla* 2-lipped; upper lip shorter than lower, convex, notched at apex, with glabrous style channel; lower lip deeply 3-lobed, middle lobe with glabrous palate of 2 longitudinal upraised folds, lateral lobes spreading. *Stamens* 2, inserted in tube with dense V-shaped ciliate region at point of insertion, exserted; anthers 2-celled, cells inserted at unequal levels on an oblique connective, upper cell with long hairs on back, lower cell glabrous behind, with long white basal spur. *Ovary* ellipsoid, 2 superposed ovules per cell; style pubescent at base; stigma sometimes distinctly capitate. *Disc* annular or urceolate, 2 small rectangular appendages on rim. *Capsule* club-shaped, apex acute, base solid, 2 prominent seed-bearing hooks in expanded distal part of each cell. *Seeds* more or less ovate, verrucose. Fig. 39 G-M.

### Distribution

*Sarojusticia* is a genus endemic to arid central and western Australia (Fig. 41).

*Sarojusticia kempeana* (F. Muell.) Bremek. ex Eichler, Suppl. Black's Fl. S. Austral. (1965) 284; W.R. Barker in Jessop (ed.) Fl. Central Austral. (1981) 337, f. 441; J. Green, Census Vasc. Pl. W. Austral. (1981) 95 — *Justicia kempeana* F. Muell., Fragm. Phyt. Austral. 11 (1880) 101 p.p. (excluding Giles collections from the Upper Ashburton River belonging to *Di cladanthera* and *Dipteracanthus*: see Typification); F. Muell., Syst. Census Austral. Pl. (1882) 99; F. Muell., Sec. Syst. Census Austral. Pl. (1889) 167; Tate, Hdbk Fl. Extratrop. S. Austral. (1890) 154; Ewart & Davies, Fl. N. Terr. (1917) 252; Gardner, Enum. Pl. Austral. Occid. (1931) 119; J.S. Beard, W. Austral. Pl. (1965) 98. — *Ecbolium kempeanum* (F. Muell.) Kuntze, Rev. Gen. Pl. 2 (1891) 980.

*Lectotype* here designated: *Kempe* 87, 1879, McDonnell Range (MEL 601997). *Other syntypes*: *Giles s.n.*, s. dat., between the Rivers Murchison and Gascoyne (MEL 601996); *Giles s.n.*, s. dat., Upper Ashburton River (MEL 601999 see *Dipteracanthus*, MEL 602000 see *Di cladanthera*). *Probable syntype*: *Giles s.n.*, s. dat., Upper Ashburton River (MEL 601998 see *Dipteracanthus*).

*Sarojusticia kempeana* (F. Muell.) Bremek., Acta Bot. Neerl. 11 (1962) 200; Chippendale, Proc. Linn. Soc. N.S. Wales 96 (1971) 259; nom. invalid (basonym not fully cited).

Erect, perennial, spreading, straggly woody shrub, 0.25-1 m high. Lower down *branches* usually with leaf scars only. *Leaves* and leaf-like bracts small, round to ovate, base attenuate, short and straight cystoliths more easily seen on lower surface, particularly on veins. *Bracteoles* smaller than leaves (3-4 mm long), similar in shape and indumentum. *Calyx* 7-9 mm long, eglandular hairs on both surfaces. *Corolla* c. 12-15 mm long, externally hairy, mauve, blue-pink, pink or purple, rarely white, palate white with darker venation. *Stamens*: filaments 0.3-0.5 mm wide, free for 5-6 mm, white, glabrous except at very base; anther cells often purple, upper cell c. 1.3 mm long, often with very short basal appendage, lower cell c. 1.6 mm long, basal appendage 0.5-0.7 mm long. *Ovary* glabrous except at very apex; style 10 mm long, sparsely hairy in lower half. *Capsule* usually shortly pubescent, more rarely, glabrous. *Seeds* pale yellow when immature, dark brown on maturity. Fig. 39 G-M.

### Typification

Only two of the specimens seen by Mueller really qualify for choice as lectotype of *J. kempeana* F. Muell. Mueller cited and annotated a collection of Rev. H. Kempe from "prope McDonnell's Range" and several collections by Giles from the Ashburton, Gascoyne and Murchison River areas. Three of the Giles collections (*MEL 601996*, *MEL 601999* & *MEL 6012000*) are annotated as "*J. kempeana* var." by Mueller and a fourth collection (*MEL 601998*) is labelled only as "*Justicia*".

Only the Kempe collection and the Giles collection from between the Rivers Murchison and Gascoyne (*MEL 601996*) have flowers and these are obviously the basis for the floral description. The other collections possess capsules only and belong to other genera (*Di cladanthera*, *MEL 602000* and *Dipteracanthus*, *MEL 601998* and *MEL 60199*) which have regular rather than 2-lipped flowers.

In choosing between the Kempe and Giles collections, the former best fits the description of the leaves as 'crenate-dentate' and is labelled as *J. kempeana* only, whereas the Giles collection is labelled as "*J. kempeana* var.". Thus, Mueller perceived the two collections as distinct and allied the Giles collection with his narrow-leaved variety (not formally published — see typification under ssp. *muelleri*). The Kempe collection is therefore chosen as lectotype of *J. kempeana* F. Muell. It consists of a number of mounted branches of the species complete with leaves and one flower, with a number of loose fragments and dissected flowers in an attached envelope which bears Mueller's rough description. No fruiting material is present.

*Distribution*: as for genus.

*Ecology*: see under subspecies.

### Notes

1. *Sarojusticia kempeana* appears to be related to *Calophanoides hygrophiloides* and it would be advisable to reassess their separation in a revision of the two genera. Because of some uncertainty about the circumscription of *Calophanoides* (see Introduction to that genus) and the position of *C. hygrophiloides* within it, it would be premature to make decisions at this time. The two genera are easily separable in Australia by their bract shapes (often toothed or crenulate in *Sarojusticia*, obcordate in *Calophanoides*), the presence of distinct leaves in *Calophanoides* as opposed to indistinguishable leaves and bracts in *Sarojusticia* and solitary flowers in the axils of *Sarojusticia* compared with a number in *Calophanoides*. However these reductions in parts in the case of *Sarojusticia* may merely reflect its occurrence in dry areas, compared with the rainforest occurrence of *Calophanoides hygrophiloides*.

Until *Calophanoides* has been revised, the need for transfer cannot be predicted. *Calophanoides* is the older name, but it has to be decided whether *C. hygrophiloides* really does belong as proposed here, or whether it is deserving of its own genus as proposed by Bremekamp (1962). Should the latter be the case, then *Sarojusticia* should be investigated as the genus for the taxon known as *C. hygrophiloides*.

2. The flowers of *Sarojusticia* and *Rostellularia* differ in size and they also differ in construction of the lower lip. Both have a palate on the middle lower lobe, but in the case of *Rostellularia* the lateral lobes are short and occur in the same plane as the middle lobe. In *Sarojusticia* the lobes are longer and spread almost at right angles to the middle lobe (see Figs 39 & 42). With respect to the stamens and pollination they display similar characteristics. When the flower is newly opened, the stamens meet above the stigma, although the orientation of the anthers appears to be different between the genera. In *Sarojusticia* the anther cells with their appendages are arranged at right angles to the line of the style and thus the appendages are not obvious. In *Rostellularia*, the anthers with their appendages are parallel with the line of the style and the appendages are very distinct. After pollination in both genera the stamens separate, although this is less noticeable in *Sarojusticia* than in *Rostellularia*, where they are more widely separate.

Both genera are presumably bee or insect pollinated; the only population of *Sarojusticia* seen in the field was being visited by honey bees, but no pollinators were observed in a number of *Rostellularia* field populations.

### Key to subspecies of *Sarojusticia kempeana*

- 1a. Leaves, bracts and bracteoles distinctly 2-3 (-5) toothed along one side, orbicular to ovate. Stigma distinctly capitate. [Stems, leaves and bracts with short, upright conical bristles, sparsely or densely all over]. Alice Springs area ..... a. ssp. *kempeana*
- 1b. Leaves, bracts and bracteoles entire or irregularly crenate, orbicular or elliptic to oblanceolate. Stigma not distinctly capitate. Western Australia ..... 2
- 2a. Stems with overlapping, flattened, slender white hairs all over. Leaves and bracts elliptic to oblanceolate, largest longer than 10 cm ..... b. ssp. *muelleri*
- 2b. Stems and leaves more or less glabrous. Leaves and bracts orbicular or obcordate, usually less than 10 cm long ..... ssp. *muelleri* (Note 2)

#### a. ssp. *kempeana*

Stems with short, upright, conical bristles, sparsely or densely all over. *Leaves* and *bracts* subsessile, or petiole to 2 mm long, blade orbicular to ovate, to 4-10 (-15) x 3-8 mm, margin 2-3 (-5) toothed along one side, in young parts more or less fleshy, covered with short conical bristles, becoming sparser with age. *Bracteoles* 1-2 toothed, similar in shape to bracts. Stigma distinctly capitate. *Capsule* 7-8 (-10) mm long, pubescent. Fig. 39 J-M.

#### *Distribution*

Ssp. *kempeana* is confined to rockholes, springs and creeks of the Alice Springs area of the Northern Territory (Fig. 41).

#### *Ecology*

*S. kempeana* ssp. *kempeana* is usually found in sheltered rocky areas on skeletal soil in sandstone country. Flowering specimens have been collected most of the year except January to March.



*Specimens examined*

NORTHERN TERRITORY: *Allwright 80*, 1.ix.1968, 45m W of Alice Springs (NT); *Anon. (Herb. Black) s.n.*, s. dat. MacDonnell Ranges (AD 96307258 p.p.); *R.M. Barker 140 & 141*, 14.iv.1983, Ooraminna Rock Hole, c. 38 km SSE of Alice Springs (AD); *Beaglehole 27680*, 26.vii.1968, Ooraminna Rockhole (AD, NT); *Chippendale s.n.*, 4.vii.1955, Ooraminna Rockhole (AD, NT); *Cleland s.n.*, 31.viii.1956, Palm Valley (AD 96306088); *Beaglehole 23626*, 11.vii.1967, Illamurta Springs, 15 m N of White Horse Gap (NT); *Johnson 31*, 1.x.1856, in Waterhouse Range, c. 2 m W of ruins, Alice Springs Road (AD); *Henshall 1402*, 13.iv.1977, Allambi Station (AD, CANB, CBG, MEL, NT); *Horn Exped. s.n.*, s. dat. Ooramin Pass [Ooraminna] (NSW 151872); *Kalotas 765*, 23.x.1980, Illamurta Springs (NT); *Kempe 87*, 1879, MacDonnell Range (MEL); *Latz 800*, 30.ix.1970, Boggy Hole, 22 m S of Palm Valley (NT); *Latz 5645*, 21.vii.1974, Todd River Station (AD); *Latz 1905*, 27.xii.1971, Larapinta Waters, Finke River (AD, CANB, NSW, NT); *Latz 9054*, 29.iv.1982, 33 km NW of Henbury Homestead (AD); *Horn Expedition s.n.*, 1894, Illpilla Gorge (McMinns Creek) and Illamurta (AD 95837013); *Nelson 480*, 21.viii.1962, Ooraminna Rockhole, 25 m S of Alice Springs (AD, CANB, NT); *Nelson 1367*, 19.x.1964, Ooraminna Rockhole, 24 m S of Alice Springs (AD, NT); *Newland 36*, vii.1887, Central Australia (MEL); *Schwarz s.n.*, xi.1888, Macdonnell Ranges (MEL 100887).

**b. ssp. *muelleri* R.M. Barker, ssp. nov.**

"*Justicia kempeana* var." F. Muell., *Fragm. Phyt. Austral.* 11 (1880) 101 p.p. (as to *Giles MEL 601996* only).

Subspecies nova *S. kempeanae*, a ssp. *kempeana* differt foliis et bracteis crenatis irregulariter, ellipticisve oblanceolatis, stigmatibus non distincte capitatis et pilis albis gracilibus complanatis in omnibus partibus.

**Holotype:** *Weber 4829*, 26.ix.1975. Along the road between Wiluna and Meekatharra (c. 120 km W of Wiluna). **Glengarry Range South (AD).** **Isotypes:** PERTH, 1 to be distributed.

Stems, petioles and leaves with appressed white eglandular hairs, at least on young parts. *Leaves* and *bracts* to 5-7 mm petiolate, blade elliptic to oblanceolate, to (10-) 15 x 5-9 mm, margin entire or irregularly crenate. *Bracteoles* usually similar in shape to leaves and bracts, sometimes rounder, rarely obcordate. *Stigma* not distinctly capitate. *Capsule* 9-10 mm long, pubescent, or rarely, glabrous. Fig. 39 G-I.

*Typification*

"*J. kempeana* var."

In his description of *J. kempeana* Mueller made 3 references to a variety, "bractee . . . in varietate angustifolia longiores et lanceolari-lineares", "capsula (solummodo in varietate angustifolia visa)" and "si varietas bracteis angustis hue pertineat" and also annotated three of Giles's collections from the Murchison and Gascoyne Rivers as *J. kempeana* var. Therefore there is no doubt that Mueller recognized a new variety, but there is some doubt whether or not he named it. It could be argued that he used the epithet 'angustifolia' but this does not appear on specimens and was never listed in any of Mueller's publications. It seems then that Mueller used 'angustifolia' to distinguish the variety but did not intend its use as a name.

In any case of the three specimens annotated by Mueller as "*J. kempeana* var.", one is the new subspecies of *Sarajusticia kempeana* (MEL 601996), one is *Di cladanthera forrestii* F. Muell. (MEL 602000) and the third is *Dipteracanthus australasicus* F. Muell. (MEL 601999). The last two collections have capsules while the first does not and as Mueller refers twice to the capsules of *J. kempeana* as being seen only from the narrow-leafed variety (see quote above), if a lectotype of "*J. kempeana* var." was to be chosen it would have to be either the *Di cladanthera* or *Dipteracanthus* specimen.

*Distribution*

This taxon is confined to the Murchison and Gascoyne regions of Western Australia. (Fig. 41).

### Ecology

Ssp. *muelleri* seems to be confined to rocky watercourse areas. Ecological annotations include "stony spots in watercourse", stony dry creek, "rocky sand near creek" and "creek bank". The only other annotations are "above mulga, on rocks" and "semi-alluvial soil". Flowering specimens have been collected between May and September.

### Notes

1. The collections *Setter 388* and *Beard 6093* are the only ones to have completely glabrous capsules. All other collections have short upright eglandular hairs over the outer surface. At this stage there seems to be no other supporting character to warrant recognition of these collections as taxonomically different.

2. The West Angelas collection of *Hos s.n.*, included here under ssp. *muelleri*, possibly warrants recognition as a separate subspecies of *Sarojusticia kempeana*. It is glabrous in all parts, has leaves, bracts and bracteoles which are almost circular or obcordate in outline, entire margins, and the largest leaves or bracts up to 10 mm long, with a petiole of 2-3 mm length. The stigma is not distinctly capitate. Since there is only a single collection it seems premature to describe this as a new taxon, particularly as *Giles MEL 601996* approaches it on vegetative characteristics, differing however in the presence of an indumentum.

The West Angelas collection has been confirmed by S. Janicke (pers. comm.) as being from the West Angelas locality in the Hamersley Ranges between Newman and Paraburdoo and not from near Noonkanbah as indicated by the latitudes and longitudes given on the specimen.

3. The subspecies is named after Ferdinand von Mueller whose "*Justicia kempeana* var." included this subspecies.

### Specimens examined

WESTERN AUSTRALIA: *Beard 6093*, viii.1970, Teano Range (PERTH, NSW); *Blackall 224*, 19.vii.1931, 3 km S of Meekatharra (PERTH); *Brockway 16*, v.1953, Peak Hill Road (PERTH); *Blockley 769*, 22.vii.1968, Boolloo [Bulloo] Downs Station, Ned's Gap (KINGS PARK); *Faisall 1860*, 23.vii.1966, 36 m E of Meekatharra on Wiluna Road (PERTH, KINGS PARK); *Gardner 2344*, 20.vii.1931, Meekatharra (PERTH — 2 sheets); *Gardner s.n.*, 13.viii.1959, Wittenoom Gorge (PERTH); *Giles s.n.*, s. dat. between the Rivers Murchison and Gascoyne (MEL 601996); *Hos s.n.*, 15.iv.1976, West Angelas (PERTH); *Kretschmar s.n.*, viii.1963, Mt Keith (PERTH); *Robinson s.n.*, 7.ix.1959, South Barlee Range (PERTH); *Setter 388*, 26.ix.1973, Aurilla Creek bank 4 m N of Dead Horse Bore on Mt James Stn, via Carnarvon (PERTH); *Speck 1251*, 19.viii.1958, 3 m S of Windidda (Christmas Range) (PERTH); *Weber 4829*, 26.ix.1975, along road between Wiluna & Meekatharra (c. 120 km W of Wiluna) (AD); *Wilcox 99*, ix.1969, Naracoota Station (PERTH).

## 26. ROSTELLULARIA Reichb.

### History

Australian collections of this genus from the east coast were first described by Robert Brown (1810) under three newly proposed names, *Justicia media*, *J. adscendens* and *J. juncea*, separable from each other chiefly by their habit and leaf shape. Subsequently, Nees von Esenbeck (1847a) reduced *J. adscendens* to a variety, var.  $\delta$ , of the Indian species of *Rostellularia procumbens* (L.) Nees, while retaining *R. media* and *R. juncea*. This was followed by Mueller in 1852 who described as new those specimens he had collected from Arkaba (in the Flinders Ranges of South Australia). Because of their hairy anther backs he gave them the name *R. pogonantha*.

In later works both Bentham (1868) and Mueller (1889) placed all four names in synonymy under *J. procumbens* L. which Anderson (1867) in his work on Indian Acanthaceae

described as a widespread and variable weed. Bentham commented on the variability within Australia, mentioning particularly the small, ovate-leaved form from New England in New South Wales and Mt Serle in South Australia, the large form, with ovate, sessile, glabrous leaves, drying black, from Endeavour River and Rockingham Bay in Queensland, and a form with bracts with white margins from Victoria River in the Northern Territory; he gave them no taxonomic status.

Subsequent Australian works by Tate (1890), Ewart & Davies (1917), Bailey (1912), Robertson in Black (1957) and Beard (1965) continued this usage of *Justicia procumbens*. Bailey and Beard recognised a further species in each of their states, respectively *J. notha* C.B. Clarke in Queensland and *J. diffusa* Willd. in Western Australia, both Indian species. *J. notha* was used to refer to the taxon from north Queensland with large ovate, glabrous leaves drying black, *J. diffusa* to the taxon with small-flowers and white-margined bracts from northern Western Australia.

Domin (1929) ascribed all Australian specimens to *J. procumbens*, but recognised a number of varieties. Two of these varieties, var. *latifolia* and var. *hispida*, were new while var. *juncea* and var. *adscendens* were based on Robert Brown's species. In addition he recognised var. *bonneyana*, based on Mueller's (1882) *J. bonneyana*, which belongs to a distinct genus *Rhaphidospora* (q.v.). Domin described the form with large, sessile, ovate, glabrous leaves from north Queensland as a new species, *J. glaucoviolacea*; the taxon from Western Australia with white-margined bracts was also considered a new species, *J. clementii*.

Bremekamp (1962) resurrected Mueller's *Rostellularia pogonantha* on the basis of the unique hairy anther backs (see later) for Central Australian specimens, a decision which has largely been followed by subsequent authors (Eichler 1965, Barker 1981, Green 1981, Cunningham et al. 1982). He did not publish further on Australian *Rostellularia* although collections in AD have been annotated by him with the unpublished combinations *R. juncea* (for narrow-leaved Queensland specimens) and *R. clementii* (for collections from near Darwin). These annotations confirm his concept of Australian material not being conspecific with the Indian *R. procumbens*.

An additional species recognised for Queensland and New South Wales has usually been referred to the Indian species *Justicia peploides* following Bentham's (1868) placement of the species here. Bailey (1883) reduced the Australian material to a variety of *J. procumbens*, while C.B. Clarke reduced the Indian material to a variety of *J. quinqueangularis*. Domin (1929) later referred collections again to *J. peploides*.

The situation prevailing before this review of the Australian taxa was that botanists in Queensland, where the major part of the variability of the genus is exhibited, recognised three species under *Justicia*. These are *J. procumbens*, *J. glaucoviolacea* and *J. peploides*. In other states authors have treated the species under *Rostellularia* using *R. pogonantha* for the common and widespread species, in New South Wales *R. peploides* (Jacobs & Pickard 1981) for the species with very widely hyaline bracts and in Western Australia (Green 1981) *R. diffusa* for the small-flowered taxon which has in this work been referred to *R. adscendens* ssp. *clementii*.

### Concept adopted in this work

This review of the Australian material recognises two species, *R. cf. obtusa* for material usually referred to *R. peploides* and *R. adscendens* for material previously referred to *J. procumbens* or *R. pogonantha*. This latter species consists of five subspecies with two of these being further divided into varieties. The decision to adopt the name *R. adscendens* for the widespread and polymorphic Australian material is discussed under that species together with consideration of its variation.

Material usually designated *Justicia* (*Rostellularia*) *peploides* in the past was found to disagree with type specimens seen from India and has been provisionally allocated to *R. obtusa* Nees. A group of specimens with affinities to *R. adscendens* ssp. *dallachyi* show some approach to type material of *R. peploides* Nees.

Only a revision of *Rostellularia* can determine the true status and position of Australian material. Work on the variation encountered in Australia indicates that a study of types will not be sufficient to elucidate the taxa. Decisions have to be made at several levels before there is any hope of a stable classification. Not only has the question of the segregate genera of *Justicia* to be resolved, but also the question of the relationships of Malesian and Australian species of *Rostellularia* to *R. procumbens* of India, needs to be thoroughly investigated. Thus, it seems likely that it will be some time before a stable nomenclature of the Australian taxa will be achieved, relying as it does on a more satisfactory world classification.

**Rostellularia** Reichb., Handbk. Nat. Pflanzensyst. (1837) 190; Nees in A. DC., Prodr. 11 (1847) 368; Bremek., Verh. Kon. Nederl. Akad. Wetensch., Afd. Natuurk. 45 (1948) 61; Bremek., Acta Bot. Neerl. 11 (1962) 197. — *Justicia* L. sect. *Rostellularia* (Reichb.) Clarke in Hook. f., Fl. Brit. India 4 (1885) 536; Clarke in Thiselton-Dyer, Fl. Trop. Africa 5 (1900) 180.

*Type species: R. procumbens* (L.) Nees from India: see Typification.

*Rostellaria* Nees in Wallich, Pl. Asiatic. Rar. 3 (1832) 76 & 100, non C.F. Gaertner 1806. — *Justicia* L. sect. *Rostellaria* (Nees) T. Anders., J. Linn. Soc., Bot. 7 (1863) 38; Benth. in Benth. & Hook. f., Gen. Pl. 2 (1876) 1109; Lindau in Engler & Prantl, Nat. Pflanzenfam. IV, 3b (1895) 349.

*Justicia* auct. non L.: Benth., Fl. Austral. 4 (1868) 549.

Prostrate to ascending herbs, usually with 6-angled or -furrowed stems constricted at nodes. *Leaves* sessile or petiolate, connected across nodes by transverse ridges, ovate to linear, large curved cystoliths sometimes mixed with smaller straight cystoliths on upper surface. *Inflorescence* a terminal dense spike of decussate overlapping bracts, sometimes bracts widely spaced and not overlapping at base of spike, each bract subtending a single flower. *Bracts* ovate to lanceolate, frequently with hyaline margin. *Bracteoles* 2 below each flower, similar to bract shape, narrower. *Calyx* segments 4, with or without remnant of fifth lobe. *Corolla* with tube widening from base, hairy inside on ridges decurrent from stamens, 2-lipped; upper lip erect, entire or notched, style channel internally eglandular hairy at base; lower lip spreading, 3-lobed, 2 lateral lobes narrower than middle lobe which is outermost in bud and with palate; indumentum on other parts variable. *Stamens* 2, exserted; filaments flattened, glabrous; anther cells 2, at unequal levels, lower with long white basal spur; staminodes none. *Ovary* 2-celled, with 2 superposed ovules per cell; style pubescent in lower half, glabrous above; stigma obscurely notched. *Disc* annular, 2 small appendages on either side. *Capsule* more or less ellipsoid, each cell distally with 2 seeds and 2 hooks. *Seed* compressed, more or less circular, tuberculate. Fig. 42.

### Typification

Nees von Esenbeck's *Rostellaria* of 1832 was predated by *Rostellaria* Gaertner (Sapotaceae) published in 1806. Because of this Reichenbach (1837) provided a new generic name *Rostellularia*. There are no species mentioned in his publication, simply a reference back to Nees's *Rostellaria*. In this case all of the species described by Nees under that genus become eligible for selection as the type of *Rostellularia*. Bremekamp (1979) in the entry for 'Index Nominum Genericorum' (also included in ING cards, 1955) cited *R. procumbens* (L.) Nees as lectotype, using as his reason that all of Nees's originally described species have at some time been included under this species.

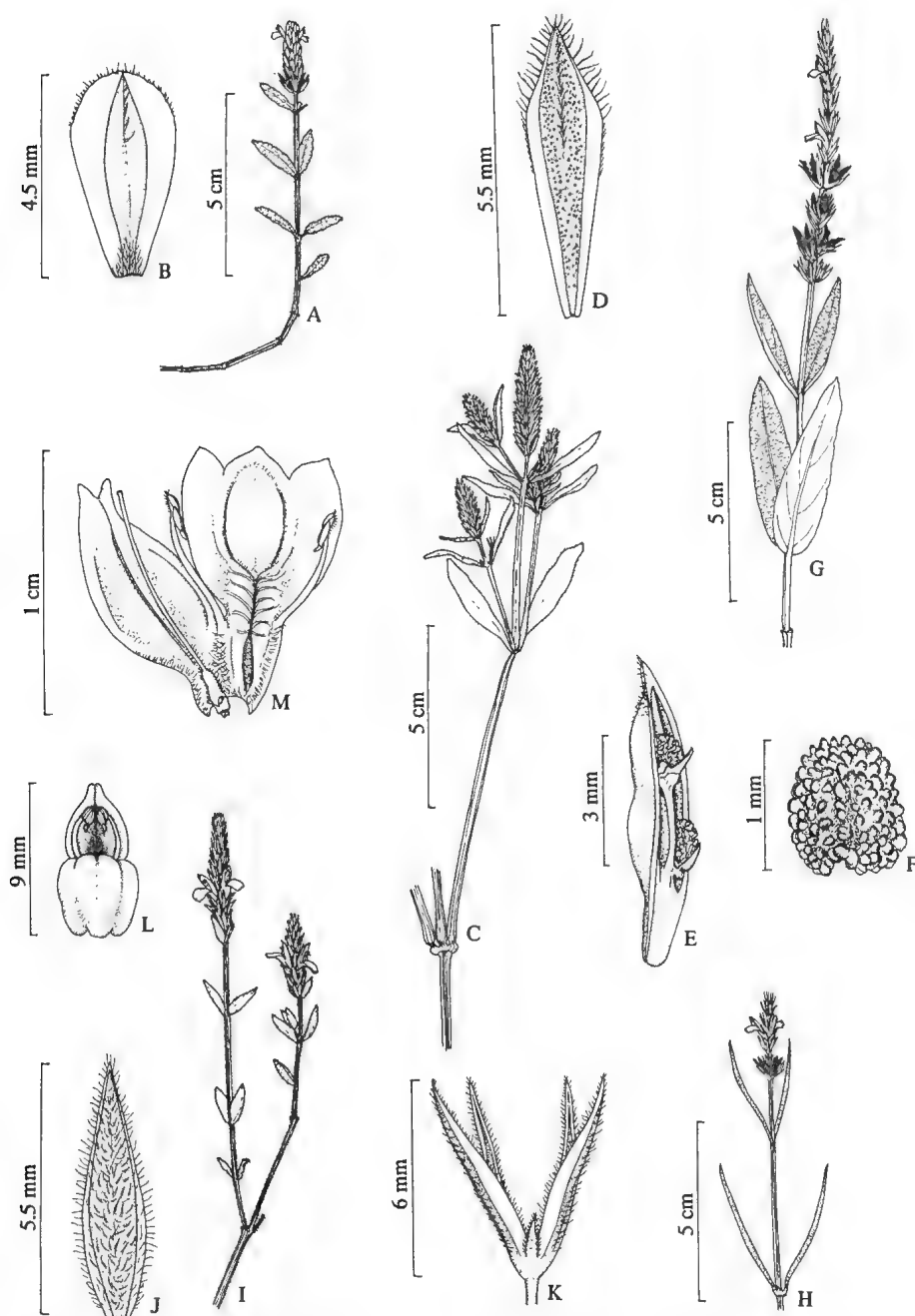


Fig. 42. *Rostellularia*. A, B, *R. cf. obtusa* Nees in A. DC. A, floral branch; B, bract (Sharp 817). C-F, *R. adscendens* (R. Br.) R.M. Barker ssp. *clementii* (Domin) R.M. Barker. C, floral branch; D, bract; E, lateral view of half a capsule containing seed; F, seed (R.M. Barker 568). G, ssp. *glaucoviolacea* (Domin) R.M. Barker, floral branch (Goodall BRI 041115). H, ssp. *adscendens* var. *hispida* (Domin) R.M. Barker, floral branch (Dockrill 362). I-M, ssp. *adscendens* var. *pogonanthera* (F. Muell.) R.M. Barker. I, floral branch (Brandy AD 97119184); J, bract; K, 4-lobed calyx with remnant of 5th lobe; L, front view of flower; M, opened flower showing style channel of upper lip, palate of lower lip, stamens decurrent as hairy ridges, hairy anther backs (J-M R.M. Barker 146).

### Distribution

*Rostellularia* occurs throughout tropical and sub-tropical Africa, Asia, Malesia and Australia with, according to Bremekamp (1948), a single species in Ethiopia. The whole genus is in need of revision and any estimate of the number of species involved is pointless. Bremekamp (1948) recognised 7 species from Java alone, and was of the opinion that the total "number of species will prove to be far more considerable than at present is assumed". However, it is suggested that the variability he recognised will prove to be mainly infraspecific. In Australia there are two species, one endemic and extremely variable occurring in all mainland States except Victoria, the other from northern New South Wales and southern Queensland of uncertain affinities, but probably most closely related to a Malesian species.

### Key to *Rostellularia* species in Australia

- 1a. Anther backs glabrous or with only a few sparse hairs on the upper cell. Bracts broadly ovate, the margin broad white (or purple) hyaline throughout; apex obtuse ..... 1. *R. cf. obtusa*
- 1b. Anther backs with hairs. Bracts narrowly to broadly ovate or lanceolate, margin frequently white (or purple) hyaline, but not continued broadly to apex; apex acute ..... 2. *R. adscendens*

#### 1. *Rostellularia* cf. *obtusa* Nees in A. DC., Prodr. 11 (1847) 374.

*Syntypes*: Zollinger 2218, 1846 and Zollinger 2046, s. dat. Java (G-herb. DC.: microfiche AD).

*Rostellularia peploides* auct. non Nees: Jacobs & Pickard, Pl. N.S. Wales (1981) 61. — *Justicia peploides* auct. non (Nees) T. Anders.: Benth., Fl. Austral. 4 (1868) 550; F. Muell., Fragm. Phyt. Austral. 11 (1878) 18; Domin, Biblioth. Bot. 89 (1929) 605. — *Justicia procumbens* L. var. *peploides* (Nees) F.M. Bailey, Syn. Qld Fl. (1883) 369; F.M. Bailey, Catal. Pl. Qld (1890) 35; F.M. Bailey, Qld Fl. 4 (1901) 1151; F.M. Bailey, Weeds & Poisonous Pl. Qld (1906) 137; F.M. Bailey, Compr. Cat. Qld Pl. (1913) 374.

Usually sprawling or prostrate, rarely decumbent herb, longitudinally furrowed branches, usually small cystoliths parallel to furrows, often white eglandular hairs in longitudinal rows on ridges, denser at nodes and on young parts. *Leaves* with slender distinct petioles 3-10 mm long, blade ovate, 0.9-3.1 x 0.4-1.4 cm, broadly cuneate at base, entire or slightly crenulate, obtuse, sparsely to moderately densely strigose on both surfaces (eglandular hairs similar to those on stem), small, irregularly-orientated cystoliths on upper darker surface. *Inflorescence* 0.5-4 (-7) cm long, usually dense throughout, not interrupted at base. *Bract* obovate, 3.5-5.5 x 1.6-2.8 mm, with wide (0.75 mm), white or purple, hyaline margin on either side continuing around obtuse, rarely emarginate apex, few short eglandular hairs on margin and sometimes on midrib, sometimes few glandular hairs on green part of bract, always with small cystoliths parallel to midrib of bract. *Bracteoles* similar but smaller than bract. *Calyx* segments 4, linear-lanceolate, with only midrib green, with hyaline remnant of fifth lobe. *Corolla* purple, pale purple or blue with paler blotches on palate, 4.5-6 mm long along upper side, externally sparsely eglandular hairy, on middle lobe with downturned delicate eglandular hairs, internally 2 V-shaped densely eglandular hairy areas at base of tube extending from filaments and an eglandular hairy region at base of groove of palate. *Anthers* with backs glabrous or with few sparse eglandular hairs. *Ovary* glabrous, ellipsoid, 1 mm long; style c. 4.5 mm long; stigma slightly expanded, faintly notched. *Capsule* 4.7-6.8 mm long, entirely glabrous or pubescent at apex only. Fig. 42 A, B.

### Distribution

Collections of *R. cf. obtusa* are mostly from Brisbane, or its environs, but it occurs as far south as Tenterfield in New South Wales and as far north as the Kroombit Tableland of south-east Queensland. Fig. 44.

### Ecology

The species has been recorded amongst grasses, in damp creek beds in open forest dominated by *Eucalyptus microcorys* and *E. intermedia* and within *Eucalyptus saligna* and *Angophora* forest. There are two records of it being found in mown areas. Soil types include sandy water-logged clay and sandstone. Flowering specimens have been collected in most months of the year.

### Notes

1. In habit this species is very similar to specimens assigned to *R. adscendens* ssp. *adscendens* var. *latifolia* and ssp. *dallachyi*, but it can be easily distinguished from these by bract shape. *R. cf. obtusa* always has obovate bracts with an obtuse apex and a very wide white margin, widest in the apical half (Fig. 42b), whereas var. *latifolia* and ssp. *dallachyi* have lanceolate bracts with acute apices and white margins widest at the base and not continuing to the apex.

2. This species has some specimens in which there are a few hairs on the anther backs, a characteristic which Bremekamp (1962) believed to be almost exclusive to Australian taxa of *Rostellularia* and the basis for the recognition of *R. adscendens* as specifically distinct from the rest of Malesian *Rostellularia* species (see *R. adscendens* Note 1). The significance of the hairs on the anther backs in *R. adscendens* needs to be investigated. Any such study may elucidate the reasons for this occasional presence in *R. cf. obtusa* in Australia.

3. If Australian material is conspecific with *R. obtusa* of Java, it seems likely that it will prove to have been an introduction to Australia during the 1800s. Its restriction to the Brisbane and northern New South Wales area would then mean that it has not spread greatly since its introduction. Alternatively, should it not be conspecific with Malesian *Rostellularia*, it could be deserving of new species status and support Bremekamp's (1948) assertion that species of *Rostellularia* would be unlikely to prove to be widespread.

The only types of *R. obtusa* Nees seen have been those on microfiche in de Candolle's herbarium in AD: these are not sufficient to enable fine detail of bract shape and indumentum to be ascertained. Although the bracts of the type material do appear more acute than those in the Australian taxon, membranous margins may be obscured on the photograph. Bremekamp (1948) referred Javan material of *R. mollissima* Nees to *R. obtusa*. This has also been seen in de Candolle's herbarium, but its conspecificity or otherwise with Australian material is similarly uncertain. Javan material identified as *R. obtusa* at K has been seen and this appears identical with Australian material.

4. Australian material referred here to *R. cf. obtusa*, cannot be referred to *R. peploides* Nees as has been done in the past. *R. peploides* differs by its narrowly-ovate bracts without glandular hairs, with a narrow hyaline margin and an acute apex, and also by its glabrous leaves.

5. A number of collections from northern coastal Queensland, particularly from Lizard Island, have proved impossible to place within the present classification. They show some approach to *R. cf. obtusa* in habit, but have been treated as *R. adscendens* aff. ssp. *dallachyi* as they agree most closely with this subspecies. They are discussed further there.

### Specimens examined

NEW SOUTH WALES: *Asser* 9, 10.iii.1941, Old Koreelah via Tenterfield (NSW); *Boorman s.n.*, vi.1916, Cangai, Upper Clarence (BRI 141928, NSW 151910); *Salasoo* 2601, 3.i.1963, On banks of Richmond R., NW of Kygogle (NSW).

QUEENSLAND: *Crisp* 2780, 4.vi.1977, c. 60 km SW of Gladstone, Kroombit Tableland, tributary of Kroombit Ck, 3.2 km SSW of Amys Peak (AD, CBG); *Everist* s.n., 4.iv.1956, Lytton Quarantine Stn, mouth of Brisbane River (BRI 030977); *Eaves* s.n., 1872, Moreton Bay (MEL 100882); *Eaves* s.n., s. dat. Broadwater (MEL 100883); *Hall* s.n., viii.1909, Ipswich (BRI 141929); *Henderson* H179, 12.ii.1967, Mt Gravatt University site, Brisbane (BRI); *Henne* s.n., s. dat. near Brisbane (MEL 100885); *Hubbard* 3038, 17.vi.1930, Indooroopilly (BRI); *Maiden* s.n., iii.1909, Maryborough (NSW 151911); *Mann* s.n., i.1957, Sherwood (BRI 141973); *Michael* 1869, 22.ix.1931, Holmview (BRI); *Mueller* s.n., vii?1885, Brisbane River (MEL 100880); *Salasoo* 5498, 30.xii.1974, Highfields 8 miles N of Toowoomba (NSW); *Sharpe* 817, 18.xi.1973, Griffith University Site, Kessels Road, Mt Gravatt (BRI); *Specht* 1352, 22.i.1949, Mt Coot-tha Reserve, Brisbane (AD); *Stuart* 377 or 20, x. Breakfast Creek, Moreton Bay (MEL); *Stuart* s.n., s. dat. Moreton Bay (MEL 101204, MEL 101268); *White* 6839, 17.vi.1930, Indooroopilly (BRI); *White and Francis* s.n., vi.1920, Goodna (NSW 151912); *Willis* s.n., 6.vi.1981, 80 Ada Vale Street, Brookfield — Ed Frazer's Aquatic Plant Nursery (MEL 101270).

## 2. *Rostellularia adscendens* (R.Br.) R.M. Barker, comb. nov.

*Justicia adscendens* R. Br., Prodr. (1810) 476, BASIONYM; R.Br., Manuscript (unpubl.) as "J. hispida".

*Lectotype* here designated: *R. Brown* s.n., 26.viii.1802, Thirsty Sound (BM); *isolectotype*: (MEL).

*Justicia media* R. Br., Prodr. (1810) 476 — *Rostellularia media* (R. Br.) Nees in A. DC., Prodr. 11 (1847) 374: see ssp. *clementii* for typification.

*Justicia juncea* R. Br., Prodr. (1810) 476. — *Rostellularia juncea* (R. Br.) Nees in A. DC., Prodr. 11 (1847) 376: see ssp. *adscendens* var. *juncea* for typification.

*Rostellularia procumbens* (L.) Nees var.  $\delta$  Nees in A. DC., Prodr. 11 (1847) 372 p.p. (as to specimens from New Holland).

*Rostellularia pogonanthera* F. Muell., Linnaea 25 (1852) 431: see ssp. *adscendens* var. *pogonanthera* for full synonymy and typification.

*Justicia clementii* Domin, Biblioth. Bot. 89 (1929) 605: see ssp. *clementii* for synonymy and typification.

*Justicia glaucoviolacea* Domin, Biblioth. Bot. 89 (1929) 605: see ssp. *glaucoviolacea* for synonymy and typification.

*Justicia procumbens* auct. non L.: F. Muell., Fragm. Phyt. Austral. 6 (1867) 91; Benth., Fl. Austral. 4 (1868) 549; F. Muell., Fragm. Phyt. Austral. 11 (1878) 18; F. Muell., Syst. Census Austral. Pl. (1882) 99; F.M. Bailey, Syn. Qld Fl. (1883) 369; F. Muell., Sec. Syst. Census Austral. Pl. (1889) 167; F.M. Bailey, Catal. Pl. Qld (1890) 35; Moore, Hdbk. Fl. N.S. Wales (1893) 346; F.M. Bailey, Qld Fl. 4 (1901) 151; F.M. Bailey, Weeds & Poisonous Pl. Qld (1906) 137, f. 237; F.M. Bailey, Compr. Cat. Qld Pl. (1913) 374; Ewart & Davies, Fl. N. Terr. (1917) 252; Maiden & Betche, Census N.S. Wales Pl. (1916) 185; Domin, Biblioth. Bot. 29 (1929) 604 (with 5 varieties); Black, Fl. S. Austral. 4 (1929) 518; Gardner, Enum. Pl. Austral. Occid. (1930) 119; Robertson in Black, Fl. S. Austral. 4 (1957) 777.

*Justicia notha* auct. non Clarke: F.M. Bailey, Qld Ag. J. 4 (1899) 464; F.M. Bailey, Qld Fl. 4 (1901) 1151; F.M. Bailey, Compr. Cat. Qld Pl. (1913) 374: see ssp. *glaucoviolacea*.

*Justicia diffusa* auct. non Willd.: Domin, Biblioth. Bot. 89 (1929) 605; Gardner, Enum. Pl. Austral. Occid. (1930) 119; Beard, W. Austral. Pl. (1965) 98: see ssp. *diffusa*.

Ascending herbs to 1 m high, lower branches often decumbent, often with woody base. *Stems* usually 6-angled, sometimes with two opposite sides furrowed, sometimes in younger parts longitudinally striped with contrasting light and dark green colour, constricted above nodes, glabrous or eglandular hairy. *Leaves* petiolate or sessile, abscission line at base, blade linear, oblong or ovate, large curved cystoliths perpendicular to midrib all over or smaller, usually curved cystoliths at angle to midrib, these either all over or accompanied by larger perpendicular cystoliths around margin of blade. *Inflorescence* a dense terminal spike, sometimes interrupted at base. *Bracts* 2 per pair of flowers, usually white margined, sometimes obscurely so, lanceolate to ovate, glabrous or with various hair coverings, almost invariably



with eglandular hairs on apical half of margin and cystoliths parallel to midrib. *Bracteoles* 2 per flower, white margined, with hyaline remnant of fifth segment always present. *Corolla* externally eglandular, hairy or glabrous inside with 2 lines of fine eglandular hairs in tube at point of attachment of filaments and clump of eglandular hairs at base of palate, palate in form of 2 longitudinal folds with darker striations. *Stamens* 2, exserted; filaments glabrous; anther cells 2 inserted at unequal levels, lower cell with long white basal appendage, dorsal surface of anther cells with eglandular hairs. *Ovary* ellipsoid, 2 superposed ovules per cell; style hairy in lower half, stigma scarcely expanded. *Disc* more or less annular, with 2 opposite appendages. *Capsule* pubescent in upper half or glabrous, 4-seeded, each seed with prominent hook at base. *Seed* dark-brown when mature, smoothly tuberculate, tubercles sometimes arranged more or less concentrically. Fig. 42 C-M.

### *Distribution*

*J. adscendens* occurs throughout Queensland, the Northern Territory and the northern half of Western Australia and extends as far south as 33° to the Flinders Ranges in South Australia and Mudgee in New South Wales.

*Ecology*: — see individual taxa.

### *Notes*

#### 1. *The correct name for the Australian species*

Bremekamp's (1962) reasons for rejecting *R. procumbens* as the correct name for the Australian material were that it differed from the true *R. procumbens* of India by the complete absence of a fifth calyx lobe, the presence of a hyaline margin on the bracts, bracteoles and calyces, the much shorter and softer hairs, the cystoliths of leaves being parallel to the midrib with very few of them 'boomerang-shaped' in Australian material compared with being transversely orientated and nearly all boomerang-shaped in India, and the presence of hairs on the anther backs.

My own observations on Australian material do not support Bremekamp's differences; there is always an hyaline remnant of a fifth calyx lobe as in Indian material, the cystoliths of the leaves in some cases (ssp. *glaucoviolacea*, and ssp. *adscendens* var. *junceae* and var. *hispida*) are all perpendicular to the midrib and boomerang-shaped, although in the rest of the taxa with ovate leaves Bremekamp's concepts hold and hairs vary from soft to hispid. Only in ssp. *adscendens* var. *junceae* and var. *hispida* do the hairs approach the coarseness of those in Malesian taxa. It is true that there is always an hyaline margin on the bracts, bracteoles and calyces, but this often occurs in Malesian taxa also.

One difference that is consistent is the presence of hairs on the anther backs of the Australian material. All of the specimens seen possess this characteristic and this has not been recorded elsewhere in the genus in Malesia, although two specimens out of a number seen from Malesia (*R. Brown s.n.* from Timor and Merrill (*Species Blancoanae* 470) from the Philippines, both housed in NSW) appear to have some hairs on their anther backs. It should also be noted that hairy anther backs are found in west African *Justicia* species which are referable to *Rostellularia* (Heine 1962). Another characteristic which needs investigating with respect to Indian and Malesian material is flower size. No material from Malesia has been seen which approaches the large flower sizes found in a number of taxa in Australia (e.g. ssp. *adscendens* var. *adscendens*, var. *pogonantha* and var. *junceae*).

As Australian material is apparently separable from Malesian material because of its hairy anther backs, it seems best at this stage to recognise it *in toto* as a distinct species. The species may occur in New Guinea, but no opportunity has occurred to examine material from there.

In assigning Australian specimens to one species, all three of Robert Brown's (1810)

epithets 'adscendens', 'juncea' and 'media' become available for selection as these all predate Mueller's (1852) more appropriate "pogonanthera". "Juncea" refers to the narrow linear leaves which are characteristic of only a small part of the complex. Material designated *J. media* by Robert Brown cannot be totally assigned to a single taxon as it comes from an intergrade region between two subspecies and the type consists of only a small fragment. I have therefore chosen to take up the epithet 'adscendens'.

Only a full revision of *Rostellularia procumbens* and related taxa throughout the whole range from India to Australia can confirm whether specific rank is justifiable for the Australian specimens.

## 2. The infraspecific taxonomy of *R. adscendens* in Australia

*R. adscendens* is highly polymorphic, containing a number of taxa which have been recognised previously either as distinct species or as varieties of *Justicia procumbens*. Because some taxa are more distinct than others, an hierarchical infraspecific classification has been adopted comprising four subspecies, with the type subspecies possessing five varieties and another subspecies containing two varieties. The relationships and delimitations of these taxa are discussed in Note 2b below.

### a. The diagnostic implications of flower size.

Within the taxa recognised there are closely related sister taxa separable primarily on flower size differences. Thus, within ssp. *adscendens*, the narrow-leaved varieties var. *juncea* and var. *hispida* and the arid associated varieties, var. *pogonanthera* and var. *latifolia* p.p., are predominantly separable on flower size as are the two varieties of ssp. *clementii*, var. *clementii* and var. *largiflorens*. Such a flower size difference probably also occurs within the presently delineated ssp. *glaucoviolacea*, but insufficient collections were available to confirm this.

The policy adopted has been to treat this character on the same basis as other morphological traits. However, as flower size is often the only apparent difference between closely related taxa which are similar vegetatively and there are sometimes flowers of intermediate size in overlap areas, the taxa which exhibit this trait have been recognised as varieties.

The small-flowered varieties are usually geographically restricted, with the exception of ssp. *adscendens* var. *latifolia* which has three disjunct distributions (Fig. 46), within each of which the small-flowered variety tends to be vegetatively similar to the large-flowered variety predominating in the same area; there may be reason to recognise them as distinct when more is known about their relationships.

It may be that small-flowered taxa are predominantly inbreeding and large-flowered taxa outbreeding as occurs in other acanthaceous genera, but further field observations are required to test this. As both flower types differ only in size and all other attributes are the same, including the palate on the lower lip, the differences may only be a reflection of the size of pollinator. This postulate is supported by the presence of copious nectar in the tube of flowers of the small-flowered taxa as well as the large-flowered taxa.

### b. Infraspecific relationships in *Rostellularia adscendens*

The variation at the subspecific level is largely discontinuous, whereas that at the varietal level, except for some differences based on flower size, is continuous where divergent ranges overlap. Some difficulty may be encountered in allocating collections to varietal rank, particularly in Queensland where the majority of taxa occur, but also in western New South Wales and northern Northern Territory.

### 3. *Subspecies*

The four subspecies of *R. adscendens* are more or less geographically distinct as well as being distinguished by readily discernable morphological traits and there should be little difficulty in assigning specimens at least at this level. The relationships between the four subspecies of *R. adscendens* are discussed briefly below in order to give an overall picture, and where appropriate, more detail of variation. The Lizard Island collections which show characteristics in common with a number of taxa have been treated under ssp. *clementii* or ssp. *dallachyi* to which they seem to be most closely related.

#### ssp. *clementii*

Occurring as it does across the whole of northern subtropical Australia (Fig. 47), ssp. *clementii* overlaps with a number of varieties of ssp. *adscendens*, but is usually easily separated by its bracts with the conspicuous hyaline margin, widest in the upper half, and the presence of glands on the green portion of the bract. Only in Queensland is there a tendency for the lower bracts of a spike to approach the shape more characteristic of ssp. *adscendens* (Fig. 42 D & J). Despite this, ssp. *clementii* can still usually be distinguished from the other taxa of ssp. *adscendens* by its small flowers (the small-flowered variety of ssp. *clementii* is the one that is most widespread and overlaps in distribution with other subspecies), usually longer petiolate leaves, lower nodes each with 3-5 branches, and crowded drooping inflorescences. The only collection showing an exception to this is from near Beaudesert in Queensland (McCray s.n., housed in BRI), which appears to have the tiny flowers of ssp. *clementii* and the bracts of ssp. *adscendens* (see under ssp. *clementii*).

Two of the anomalous Lizard Island collections (Macgillivray 39 and Fosberg 5501) approach ssp. *clementii* in their habit and to some extent their bract shape.

#### ssp. *adscendens*

As discussed above, this subspecies and ssp. *clementii* can usually be separated by their bract shape, although specimens occur in Queensland with intermediate bract shape. From ssp. *glaucoviolacea* and ssp. *dallachyi*, both in north-east Queensland, ssp. *adscendens* can be easily separated by the presence of hairs on the bracts, bracteoles and calyces. In addition the narrow, linear leaves of the two varieties of ssp. *adscendens* occurring here are very different from the broadly ovate leaves of ssp. *glaucoviolacea* and ssp. *dallachyi*.

There is usually no difficulty in separating ssp. *adscendens* and ssp. *dallachyi* although some of the Lizard Island collections (treated as aff. ssp. *dallachyi*), by their bract shape, the presence of stalked glandular hairs on the green portion of the bract and their narrowly ovate leaves, show some resemblance to ssp. *adscendens* var. *hispida*.

#### ssp. *glaucoviolacea*

This taxon, confined to the Herberton-Cairns area of north-east Queensland, is usually easily recognizable by its sessile, often auriculate, glaucous leaves which often turn black on drying. All of the cystoliths of the leaves are large, curved and arranged perpendicularly to the midrib. In addition it is glabrous in practically all of its parts, making it easy to distinguish from ssp. *adscendens* and ssp. *clementii*. Ssp. *glaucoviolacea* is closely related to ssp. *dallachyi* which also occurs in north-east Queensland, but the latter differs by its petiolate leaves with cystoliths which are not all arranged perpendicularly to the midrib. The two also differ in ecology, with ssp. *dallachyi* collected from the ranges close to the coast, and ssp. *glaucoviolacea* further inland.

A few collections from outside the main distributional range of ssp. *glaucoviolacea* (q.v., Note 2) approach ssp. *adscendens* var. *hispida*.

ssp. *dallachyi*

Ssp. *dallachyi* is characterized by its petiolate, ovate leaves and glabrous bracts and bracteoles. Collections of the subspecies are rare and all are from the Rockingham Bay area of Queensland.

The Lizard Island collections have affinities to ssp. *dallachyi*, but as indicated above, they also approach ssp. *clementii* and ssp. *adscendens*. In addition, there are three collections, also treated under this subspecies, which in their habit approach the other Australian species, *R. cf. obtusa* Nees. Normally these taxa, *R. cf. obtusa* and *R. adscendens* ssp. *dallachyi*, are easily separable on their bract shape and indumentum and by the glabrous leaves of ssp. *dallachyi* as opposed to the strigose ones of *R. cf. obtusa*.

## ssp. 'Irvinebank'

This taxon has not been formally described as it is represented by only one collection and it possibly comes from an area influenced by mining activities. It has affinities with ssp. *glaucoviolacea* because of its glabrous parts, but its narrow leaves also resemble the two narrow leaved varieties of ssp. *adscendens*, although the leaves are shorter and more rigid than those of ssp. *adscendens*.

## 4. Varieties

Within ssp. *clementii* two varieties have been recognized, while there are five within ssp. *adscendens*. Variation is continuous and seems largely clinal. Accordingly it has been more difficult to clearly delimit the taxa.

Varieties of ssp. *clementii*

The two varieties recognized under this subspecies, var. *clementii* of subtropical Australia and var. *largiflorens* of Arnhem Land are distinctive, but the differences break down in an area of distributional overlap. As a result the two varieties are separated somewhat artificially. Specimens of ssp. *clementii* are many-branched, shrub-like and have tiny flowers (c. 4 mm along the upper surface), bracts gland-dotted on the green portion and leaves relatively short and ovate. Those of ssp. *largiflorens* are fewer branched herbs, with larger flowers (up to 9 mm along the upper surface), the bracts often lack glands and the leaves are longer and narrower.

Varieties of ssp. *adscendens*

Three varieties of ssp. *adscendens* form part of a cline occupying an area from eastern tropical coastal Queensland (var. *juncea*) to arid central Australia (var. *pogonantha*), with var. *adscendens* occupying a central position in Queensland and New South Wales (Fig. 45). With increasing aridity the plants exhibit a gradual reduction in leaf size, a progressive increase in pubescence of all parts and reduction from a slender elongated herb to a woody many-branched shrub. As in ssp. *clementii*, at their extremes the varieties are very distinctive, but due to the gradual transition from one variety to another the boundaries between them are not clear-cut. The variety occupying the central position, var. *adscendens*, because it overlaps the other varieties, is most difficult to define, whereas var. *juncea* and var. *pogonantha* are more easily recognised.

The problem is further compounded by the existence of two forms within var. *pogonantha*, where plants from central Australian ranges ("hairy" form) are often distinguishable from those of areas further south and east ("glabrous" form) by their indumentum and flower size. This variation is not formally dealt with here and is discussed under var. *pogonantha* (Note 1.).

The three varieties are separated primarily on the leaf length: breadth ratio, pubescence and the distribution of the large curved cystoliths on the upper leaf surface.

A fourth taxon var. *hispid*a is possibly part of the above complex. It overlaps with var. *juncea*, to which it bears a close resemblance by its habit and long linear leaves having large curved cystoliths on the upper surface. The two differ in flower size, those of var. *hispid*a being smaller than those of var. *juncea*, and often the bract indumentum, those of var. *juncea* always with long stalked glandular hairs, which only rarely occur in var. *hispid*a. Var. *hispid*a is usually found further north along the Queensland coast than var. *juncea* and seems to be found further inland than the normal coastal collections of var. *juncea*.

A fifth variety, var. *latifolia*, is the most unsatisfactorily delimited taxon. It consists of plants from three widely disjunct regions of Australia (Fig. 46), united on their small flower size, and tending to resemble vegetatively the larger-flowered taxon occurring in the same area.

### Key to subspecies of *R. adscendens*

- 1a. Bracts, bracteoles and calyx segments glabrous except for a few sparse hairs on margin in the apical half. Capsule glabrous. Leaves glabrous ..... 2
- 1b. Bracts, bracteoles and calyx segments hairy on regions other than just the margin in the apical half. Capsules with eglandular hairs at least in apical half. Leaves usually hairy at least on midrib and margins ..... 4
- 2a. Leaves, bracts and bracteoles usually glaucous, often drying black. Leaves sessile, often auriculate at base, 3-17 mm wide, [with large, slightly curved cystoliths perpendicular to midrib and visible to naked eye (at least in dried specimens)]. Atherton region, N. Queensland ..... c. ssp. *glaucoviolacea* p. 272
- 2b. Leaves, bracts and bracteoles not glaucous, often drying a dark green or blackish-green. Leaves petiolate or if sessile, less than 4 mm wide, never auriculate at base ..... 3
- 3a. Leaves sessile, entire, rigid, linear, 10-15 x 1 mm, with all cystoliths large curved and perpendicular to midrib. Irvinebank area, N. Queensland ..... e. ssp. 'Irvinebank' p. 275
- 3b. Leaves petiolate, often crenulate, not rigid, broadly ovate, 20-40 x 10-25 mm, with large cystoliths perpendicular to midrib confined to margin, those within margins smaller and at an angle to midrib. Cardwell Range, N. Queensland ..... d. ssp. *dallachyi* p. 274
- 4a. Bracts lanceolate, with very conspicuous, 0.2-0.5 mm wide hyaline margin, widest at 1/2-3/4 length from base; apex usually cuspidate, sometimes acute. Bract and bracteoles with more or less sessile glandular hairs on non-hyaline portion, usually dense, rarely sparse or lacking, mixed with slender eglandular hairs along margin in apical half ..... 5
- 4b. Bracts ovate with often inconspicuous narrow hyaline margin widest in lower half; apex acute. Bract and bracteoles with eglandular hairs along margin and usually on rest of non hyaline portion of bract, often mixed with smaller, usually stalked, glandular hairs (Qld, NSW, NT, SA) ..... a. ssp. *adscendens* p. 255
- 5a. Flowers conspicuous, with corolla 6.5-9 mm long along upper side. Style 4-7 mm long ..... 6
- 5b. Flowers tiny, with corolla 3.3-5.5 (-6.5) mm long along upper surface. Style 2-4 mm long (WA, NT, Qld, SA) ..... b. ssp. *clementii* p. 267
- 6a. Bracts 2-3 mm wide, with margins glabrous or lined by short (0.1 mm long) eglandular hairs (coastal north eastern Queensland) ..... ssp. *dallachyi* (see Note 2).
- 6b. Bracts 1-1.8 mm wide, with margins lined by eglandular hairs c. 0.5 mm long, (northern Australia, particularly Arnhem Land) ..... b. ssp. *clementii* p. 267

### a. ssp. *adscendens*

*Justicia adscendens* R. Br., Prodr. (1810) 476; see species for typification.

*Justicia media* R. Br., Prodr. (1810) 476. — *Rostellularia media* (R. Br.) Nees in A. DC., Prodr. 11 (1847) 374. The type collection is intermediate between ssp. *clementii* and ssp. *adscendens* (see under the former for typification).

*Justicia juncea* R. Br., Prodr. (1810) 476. — *Rostellularia juncea* (R. Br.) Nees in A. DC., Prodr. 11 (1847) 376. (see var. *juncea* for synonymy and typification).

*Rostellularia pogonanthera* F. Muell., Linnaea 25 (1852) 431: see var. *pogonanthera* for full synonymy and typification.

*Justicia procumbens* auctt. non L.: F. Muell., *Fragm. Phyt. Austral.* 6 (1867) 91; Benth., *Fl. Austral.* 4 (1868) 549 p.p. (excluding specimens from 'N. Australia'); F. Muell., *Fragm. Phyt. Austral.* 11 (1878) 18 (as to *Woolfs, Giles and Birch* collections); F.M. Bailey, *Qld Fl.* 4 (1901) 1151 (partially excluding R. Brown's Carpentaria collection: see *J. media*); Maiden & Betche, *Census N.S. Wales Pl.* (1916) 185; Ewart & Davies, *Fl. N. Terr.* (1917) 252 p.p. (only as to collection from Haast's Bluff); Domin, *Biblioth. Bot.* 29 (1929) 604 (only as to the varieties *juncea*, *hispida*, *adscendens* and *latifolia*); Black, *Fl. S. Austral.* 4 (1929) 518; Robertson in Black, *Fl. S. Austral* 4 (1957) 777.

Few- to many-stemmed herb, or small more or less compact shrub, usually pubescent, more rarely almost glabrous. *Leaves* sessile or shortly petiolate, narrow linear to shortly-ovate, variously pubescent (see varieties). *Bracts* ovate, white margin widest in lower 2/3, variously pubescent (see varieties). *Bracteoles* similar to bract. *Calyx* segments narrower and longer, or equal to bract and bracteole. *Corolla*: upper lip white, lower lip pink, purple or mauve with white-barred areas on palate, externally hairy, frequently with group of more robust eglandular hairs on outside of middle lobe of lower lip. *Capsule* pubescent. Fig. 42 H-M.

### Distribution

*Ssp. adscendens* is found throughout New South Wales, extending into central Australia and along the eastern coast of Queensland. The two wide ranging varieties of the subspecies, var. *pogonantha* and var. *adscendens* cover most of the distributional area while two others, the narrow leaved varieties var. *juncea* and var. *hispida*, are found along the Queensland coast. There is some overlap in distribution with *ssp. clementii*, but for the most part this taxon is found further north than *ssp. adscendens* in subtropical Australia. See individual varieties for full distribution. Fig. 44-46.

*Ecology*: See individual varieties.

### Key to varieties of *ssp. adscendens*

For a discussion of the relationships of the varieties of *ssp. adscendens* see Note 4 (p. 254) at the beginning of the species. Approximate localities have been included in the key as an aid to identification, but in the case of the two widespread varieties their boundaries are artificial. Specimens from intermediate areas are listed after one of the varieties and cross-referenced under the other.

- 1a. Leaves narrow-linear, more or less sessile, at least 8 times longer than wide, with upper surface with conspicuous curved cystoliths perpendicular to midrib. Nodes and young parts not conspicuously white hairy; plants usually more or less glabrous, sometimes hispid or strigose. (East coastal Queensland from Cape Flattery to Rockhampton) ..... 2
- 1b. Leaves ovate to linear, shortly petiolate, less than 8 times longer than wide, with upper surface usually with cystoliths obscure to unaided eye and only those on margin perpendicular, the rest irregularly oriented. Nodes and young parts often conspicuously white-hairy with soft, weak eglandular hairs ..... 3
- 2a. Corolla 8-10 mm long along upper side. Style 5.7-7 mm long. Bracts with conspicuously stalked glandular hairs on green portion and conical 2-3-celled eglandular hairs on margin and midrib. (Coast between Cairns and Shoalwater Bay, Qld) ..... ii. var. *juncea*
- 2b. Corolla 5.5-7 (-7.5) mm long along upper side. Style 3-5 mm. Bracts glabrous apart from eglandular hairs on margin and midrib or bracts with glandular hairs either more or less sessile or stalked. (Cooktown to Ayr; coastal localities in Cooktown area, otherwise inland) ..... iii. var. *hispida*
- 3a. Corolla 4-6 (-7) mm long along upper side. Style 3-5 mm long. [Leaves broadly ovate, glabrous to hispid.] (Wittenoom, W. Australia, MacDonnell Ranges & central Australia, northern tablelands of New South Wales and throughout Queensland) ..... v. var. *latifolia*
- 3b. Corolla greater than 6 mm long along upper side. Style 5-6 mm long ..... 4
- 4a. Many-stemmed, sparse to dense, green to grey-green, perennial herb, often hirsute through the dense soft more or less appressed, white hairs all over or these confined to nodes and young parts (visible with naked eye). Leaves ovate, 2-3 times longer than broad on very short 1 mm long petioles. [Plants almost always with tiny vegetative shoots with almost orbicular leaves on woody base of plant] (Central Australia) ..... iv. var. *pogonantha*
- 4b. Few, rarely many-stemmed, glabrous or sparsely hairy, light to dark-green herbs with nodes and young parts only usually with sparse soft white hairs, otherwise glabrous. Leaves broad to narrow-ovate to linear-oblong, (2-) 3-6 times longer than broad, on short 1-3 mm long petioles. (N.S. Wales and southern Q) ..... i. var. *adscendens*

i. var. *adscendens*

*Justicia procumbens* auct. non L.: F. Muell., *Fragm. Phyt. Austral.* 6 (1867) 91; Benth., *Fl. Austral.* 4 (1868) 549 p.p. (at least as to Brown's collections from Thirsty Sound and numerous other collections seen but not cited by Bentham e.g. *Barton*, *Stuart* from New England, *Dalton*, *Bowman*, *Mueller*, *Thozet*, *O'Shanesy* and *Waldo Looker* collections listed below); F. Muell., *Fragm. Phyt. Austral.* 11 (1878) 18 (at least as to *Woolfs* and *Birch* collections); F.M. Bailey, *Qld Fl.* 4 (1901) 1151 p.p. (at least as to *R. Brown's* collection from Thirsty Sound and others not cited); — var. *adscendens* (R.Br.) Domin, *Biblioth. Bot.* 89 (1929) 604.

*Rostellularia pogonantha* F. Muell.: Jacobs & Pickard, *Pl. N. S. Wales* (1981) 61 p.p. (as to more easterly occurrences in New South Wales).

Light to dark green herb to 10-50 cm high, with few, rarely many, branches. *Branches*, usually erect, rarely procumbent, glabrous, or with sparse white, more or less appressed hairs particularly on nodes and young parts, not visible with unaided eye, more rarely, hairy all over. *Leaves* on short, but usually distinct 1-3 mm long petiole, base narrow-cuneate, entire, apex acute to obtuse; blade broadly to narrowly ovate to linear-oblong, (6) 13-30 (-52) x (1.6) 2.2-5.5 (-9) mm, (2) 3-6 (9) times longer than wide, glabrous or with sparse appressed white hairs either on both surfaces or on lower surface only, larger cystoliths usually not visible with naked eye on margins of upper surface, more or less perpendicular to midrib, the rest irregularly arranged. *Bracts* 3.2-5 (-6.5) x (0.6-) 0.9-1.5 mm, eglandular hairy on margin and midrib, sometimes small glandular hairs all over. *Corolla* 6-8 mm long along upper surface. *Ovary*: style 5-6 mm long. *Capsule* 6-7.5 mm long. *Seed* 1-1.6 mm long.

*Distribution*

*R. adscendens* ssp. *adscendens* var. *adscendens* is distributed chiefly over north-east New South Wales and south-east Queensland with occasional records further north from east coastal Queensland. Fig. 45.

*Ecology*

Var. *adscendens* seems to be chiefly associated with open *Eucalyptus* forest where *E. albens*, *E. melanophloia*, *E. hemiphloia*, *E. crebra* and *E. melliodora* have been recorded; understories in these associations include the grasses *Stipa*, *Themeda* and *Aristida armata*. Soil types recorded range from shallow chocolate clay loam on basalt, sandstone, grey silty clay, skeletal quartzite, red brown gravelly sand, skeletal loam on acidic volcanic rock and granitic soil. There is one record of it from pasture (Reeve 39). Flowering specimens have been collected from October to April.

*Note*

Var. *adscendens* overlaps in distribution with a number of the infraspecific taxa of *R. adscendens* described here. Where this overlap occurs there is often difficulty in separating taxa. In Central Queensland and New South Wales where the variety overlaps with ssp. *clementii* and ssp. *adscendens* var. *pogonantha*, ssp. *clementii* is usually easily separated by its habit and bract shape and indumentum, but the bract shapes of the two taxa approach each other in some collections making identification difficult (see under ssp. *clementii*). Within the overlap zone of var. *pogonantha* and var. *adscendens* the definition of the two varieties is based primarily on indumentum and leaf length breadth ratio. While the two taxa are quite distinct at their extremities, they do approach each other phenotypically in the overlap area in central New South Wales and south-central Queensland (see under var. *pogonantha* for a list of such specimens).

In eastern coastal Queensland var. *hispida* and var. *adscendens* overlap in distribution to some extent, although it should be noted that all such specimens tend to be hispid.

The major differences between the two varieties, *adscendens* and *hispida*, are in the narrowness of the leaves, the former being 8-40 times longer than broad and the latter (2) 4-6 (-9) times, the nature of the cystoliths on the leaves and the size of the flowers. In var. *hispida* the cystoliths are all large (visible to the naked eye), curved and perpendicular to the midrib. In var. *adscendens*, where the leaves are usually more ovate, the large curved cystoliths, if present, are confined to the margin of the leaf while the majority of the leaf possesses smaller, irregularly orientated cystoliths. There is a group of specimens close to var. *hispida*, but approaching var. *adscendens* in both leaf shape and distribution of cystoliths on the leaves. Most of the specimens come from the distributional area of var. *hispida* where there are only a few records of var. *adscendens*, but *Bowman* MEL 101174 from Herbert Creek occurs in an area from which only var. *adscendens* and the large-flowered var. *junceae* are recorded. Another collection *Henderson* 188 occurs even further out of the range of var. *hispida* at Moura in south-east Queensland; it lacks the large noticeable cystoliths of that variety.

*Representative and cited specimens examined* (c. 119 specimens seen)

ssp. *adscendens* var. *adscendens*

NEW SOUTH WALES: *Cunningham* 3948 & *Milthorpe*, 22.ix.1975, Little Mount, S of Mt Foster, N of Warren (NSW); *Curtin* s.n., 27.ii.1953, Backyamma State Forest, 15 m NE of Forbes (NSW 23544); *Cleland* s.n., 23.i.1912, Moree and x.1915, Dubbo (AD 96307268); *Coveny* 2416, 7.xi.1969, 17.5 m c. W of Muswellbrook on the Sandy Hollow road (NSW); *Constable* s.n., 29.iv.1952, Mt Harris Stn, Macquarie R, just S of Macquarie Marshes (NSW 20341); *Jessup* & *Gray* 2690, 16.ii.1954, Mingoola Dam Site, Severn R, 40 m W of Tenterfield (CANB); *Moore* 4931, 20.iv.1967, 'Tundulya', c. 25 m S.E. of Louth (CANB); *Reeve* & *Cook* 39, 11.iii.1972, St Antoine Farm, Cassilis, 45 m N of Mudgee (CANB); *J. Rodway* 6736, v.1933, Birraway, near Coonabarabran (NSW); *Rupp* s.n., ix.1932, Pilliga (NSW 151929); *Salasoo* 2311, 7.i.1962, Binnaway Rd, 5 m SSE of Coonabarabran (NSW); *Stuart* 87, ?1860's, New England (MEL 101162 & 101198); *Streimann* 725, 11.xii.1973, Deriah State Forest, 23 km E of Narrabri (CBG); *Tame* s.n., 28.iii.1982, Muswellbrook (NSW); *Taylor* s.n., 1870, Mudgee (MEL 101214); *Willis* s.n., 13.v.1969, Warrumbungle National Park. Along Burbie track to Mt Exmouth (MEL 101154).

QUEENSLAND: *Blake* 2168, 28.i.1931, One Mile Creek, Lawnton, 17 m N of Brisbane (BRI); *Butler* s.n., i.1960, Hutton Ck, 4-5 m downstream from intersection with Carnarvon Highway (BRI 025273); *Crisp* 2604, 28.v.1977, Mt Walsh, 6 km S of Biggenden (CBG); *Dietrich* 1542, 1863-5, Brisbane River (but see next specimen) (AD 97941106, CANB 282763); *Dietrich* 1542, viii.1865, Rockhampton (MEL 100933); *Jacks* s.n., 22.ix.1974, Running River, Mt Spec (BRIU — S-5643); *Mueller* s.n., vii.1855, Brisbane R. (MEL 101196); *Persietz* s.n., 1887, Cooktown (Endeavour River) (MEL 101193); *Purdie* 128 & *Boyland*, 24.iii.1976, on side track leading from Charleville-Augathella Rd, c. 14 km from Augathella (BRI); *Sharpe* 532 & *Hocking*, 20.viii.1973, Isla Gorge, c. 28 km SW of Theodore (BRI); *Smith* 543, 6.xii.1938, Kindon Stn, c. 54 m NNE of Goondiwindi (BRI); *Smith* 3052, 16.iv.1947, Kingaroy (BRI — 2 sheets).

*Specimens aff. var. adscendens*

QUEENSLAND: *Batianoff* 605 & *MacDonald*, 7.ix.1977, 2.5 m SE of Yeppoon, Wreck Pt (BRI); *O'Shanesy* 8 ser. 10, 2.v.1868, Summit of Mt Archer (MEL).

*Specimens intermediate between var. adscendens and var. hispida*

QUEENSLAND: *Anon.* s.n., s. dat. R. Daintree (MEL 101177 p.p.); *Barclay Miller* s.n., xii.1890, Walsh (BRI 141424); *Berthand* s.n., 1882, Cleveland Bay (MEL 100895); *Bowman* s.n., s. dat. Herbert Ck (MEL 101174); *Brass* 2427, 9.iv.1932, Slopes of Mt Fraser (BRI); *Cassels* (*Flecker* Herb. 14838), 10.vi.1967, Watsonville (QRS); *Dallachy* 95, 30.xii.1867, Queensland (MEL — 2 sheets); *Flecker* 447, 21.iv.1935, Mt Mulligan (QRS); *Henderson* 188, 26.ii.1967, Moura (BRI); *Persieh* s.n., s. dat. Endeavour R. (MEL 100942); *Persieh* 122, 1881, Endeavour R. (MEL); *Persieh* 763, 1882, Endeavour R. (MEL); *Smith* 4562, 14.ix.1950, Causeway-Collinsville (BRI — 2 sheets, NSW).

For specimens intermediate between var. *adscendens* and var. *pogonantha*, see after the latter variety.

ii. var. *junceae* (R. Br.) R.M. Barker, comb. nov.

*Justicia juncea* R. Br., Prodr. (1810) 476; BASIONYM. — *Rostellularia juncea* (R. Br.) Nees in A. DC., Prodr. 11 (1847) 376. — *Justicia procumbens* L. var. *junceae* (R. Br.) Domin, Biblioth. Bot. 89 (1929) 604 p.p. (only as to R. Brown's type material).



*Lectotype here designated: R. Brown s.n.*, 3.ix.1802, Shoalwater Bay and Broad Sound (BM p.p. — only the lower specimens on the sheet; isoelectotype: (MEL 601995); syntype: *Brown 33*, 14.viii.1802, Keppel Bay (BM p.p. — upper specimens on the sheet).

*Justicia procumbens* L. var. *adscendens* (R. Br.) Domin, Biblioth. Bot. 89 (1929) 604 p.p. (as to *Dietrich 2603*, Domin specimen n.v.).

*Justicia procumbens* auct. non L.: Benth., Fl. Austral. 4 (1868) 549 p.p. (as to R. Brown's specimens from Shoalwater and Keppel Bays and from Broad Sound); F.M. Bailey, Qld Fl. 4 (1901) 1151 p.p. (as to R. Brown's collections from Keppel and Shoalwater Bays and from Broad Sound).

Few-branched, erect or decumbent herb to 3-40 cm high, each branch simple or dichotomous, more or less glabrous, 6-angled and 2-furrowed, often contracted above node, with small cystoliths parallel to stem, most dense on angles. *Leaves* more or less sessile, base broad-cuneate, entire, acute, narrow-linear to linear-oblong, 20-55 x 1-3.5 (-5) mm, glabrous or with sparse, coarse eglandular hairs; upper surface with large curved cystoliths visible to unaided eye, all perpendicular to midrib. *Bract* 4-6 x 0.6-1.2 mm, stalked glandular hairs on green portion, robust 2-3-celled, conical, eglandular hairs on midrib and margin. *Corolla* 8-10 mm long along upper side. *Ovary*: style 5.7-7 mm long. *Capsule* 6-7.5 mm long. *Seed* 1-1.5 mm long.

### Typification

Brown (1810) recognised two taxa within *J. juncea*, one with glabrous parts and the other with pubescent parts. Within his unpublished manuscript he lists three of his own collections as *J. juncea*. These are no. 33 from Keppel Bay, collected on 14.viii.1803, specimens from Shoalwater Bay and Broad Sound on 3.ix.1802 and a collection from the Gulf of Carpentaria mainland near Groote Eylandt. This last specimen bears an inscription where he subsequently crossed through the epithet 'juncea' and replaced it with 'media'. In BM there is a single sheet with collections from Keppel Bay and Shoalwater Bay/Broad Sound on it. The Keppel Bay collection has been annotated by Brown as *Justicia juncea*  $\beta$  of the Prodrumus and thus must have the leaf surface and branches hairy. It consists of the top middle specimen on the sheet (Fig. 43), possibly together with the specimens on either side of it. The Shoalwater Bay and Broad Sound collections (representing  $\varphi$  of the Prodrumus) on the lower half of the sheet tend to be narrower and longer in leaf than the Keppel Bay collection and the leaves are subglabrous. Since there appears to be more material of the Shoalwater Bay and Broad Sound collections these have been designated as lectotype. The Keppel Bay collection by its shorter and wider leaves approaches ssp. *adscendens* var. *adscendens*.

### Distribution

*R. adscendens* ssp. *adscendens* var. *juncea* is known only from eastern coastal areas of Queensland between Cairns and Shoalwater Bay. Fig. 44.

### Ecology

The few ecological annotations refer to open *Eucalyptus* forest, sandy soil of a small creek, *Licuala*-dominant palm forest. Flowering specimens have been collected from February to May with isolated records from November and July.

### Notes

1. *Webb & Tracy 5854* from further north and inland near Atherton, north Queensland, has affinities to var. *juncea* even though the leaves are much wider (8-10 mm) than the normal



Fig. 43. Syntypes and lectotype (lower specimens) of *Justicia juncea* R. Br.

range for var. *junceae* (up to 5 mm), and only the marginal cystoliths are large and perpendicular to the midrib. In other respects it agrees with the variety. It was collected from "low woodland on chernozemic soil on scoria cone".

2. The collection *Gittins 523* is represented in NSW by the large-flowered var. *junceae*, but the duplicate in BRI is very definitely small-flowered and referable to var. *hispida*. As there are a number of plants in the total collection it seems strange that they have sorted in this fashion and it confirms that field work is necessary to clarify the large and small-flowered differences between or within taxa.

### *Specimens examined*

QUEENSLAND: *Birch s.n.*, 1886, Don R., nr Edgcombe Bay (MEL 100937); *Blake 15637 & Webb*, 19.iv.1945, S of Stanage Bay (NW end of Shoalwater Bay) (BRI); *Boylard 572*, 27.xi.1967, 9.5 km E of Tully (BRI); *Brown s.n.*, 3.ix.1802, Shoalwater Bay & Broadsound (BM p.p., lectotype, MEL 601995); *Brown 33*, 14.viii.1802, Keppel Bay (BM: p.p.); *Clarkson 720 & Stanley*, 6.viii.1977, Shoalwater Bay Military Reserve. C.S.I.R.O ISOPOD site, c. 2.5 km N of Mt Parnassus (BRI); *Dallachy s.n.*, s. dat., Nr Port Denison (MEL 101217); *Dietrich 120*, s. dat. Prope Mackay (MEL 101256); *Dietrich 2603*, s. dat. Port Mackay (MEL, NSW); *Gittins 503*, v.1962, Paluma-Running River Rd (BRI); *Gittins 523*, vi.1962, Stannary Hills (NSW); *Hines & Vessey s.n.*, 12.xii.1962, Rollingstone (BRIU S-49411); *Jacks s.n.*, 27.iii.1974, Emmett Ck, Townsville (BRIU S-5336a); *Johnson s.n.*, 1876, Cleveland Bay (MEL 101192); *Michael s.n.*, s. dat., Proserpine (BRI 141402); *Wrigley & Telford NQ 287*, 31.v.1972, 1 m from Tinaroo Dam towards Danbulla (CBG); *Sayer s.n.*, 1886, Barron River (MEL 100932).

### Specimens aff. var. *junceae*

QUEENSLAND: *Webb & Tracey 5854*, 21.ii.1962, Seven Sisters near Atherton (BRI).

### iii. var. *hispida* (Domin) R.M. Barker, comb. nov.

*Justicia procumbens* L. var. *hispida* Domin, Biblioth. Bot. 89 (1929) 604: BASIONYM.

*Lectotype here designated*: Domin 8417, ii.1910, In silvis tropodrymiis prope Mareeba (PR p.p.); syntype and probable isolectotype: *Domin 8416*, same locality as *Domin 8417* (PR p.p.: mounted on same sheet as lectotype).

*Justicia procumbens* L. var. *junceae* (R. Br.) Domin, Biblioth. Bot. 89 (1929) 604 p.p. (as to all Domin and Dietrich specimens cited but excluding Robert Brown's type material and thus invalid).

Erect herb, 10-40 cm high, with few simple or dichotomously branched stems arising from woody base. *Branches* 6-angled, 2-furrowed, small dense cystoliths parallel to main axis, particularly dense on angles, glabrous or more commonly with sparse 2-3-celled eglandular hairs all over. *Leaves* on short (0.5-1.5 mm) petioles; blade narrow linear to linear-oblong, 10-40 x 1-3.5 (-5) mm, base broad-cuneate, entire, apex acute, sparse to moderately dense eglandular hairs all over, or confined to midrib and margins, rarely (Note 1) with sessile glands on petiole and furrow of midrib on lower surface, large slightly curved cystoliths on upper surface all perpendicular to midrib, visible with unaided eye. *Bracts* 3.5-4.7 x 0.8 mm, with eglandular hairs on margin and midrib, sometimes with glandular hairs. *Corolla* 5.5-7 (-7.5) mm long along upper side. *Ovary*: style 3-5 mm long, ? mauve for whole length (*Gittins 523*). *Capsule* (3.3-) 4-6 mm long. *Seed* 0.9-1 mm long. Fig. 42H.

### *Typification*

The two Domin syntype collections, both mounted on the same sheet, while matching the protologue are somewhat atypical of the rest of the material assigned to this taxon since they are more hispid than usual.

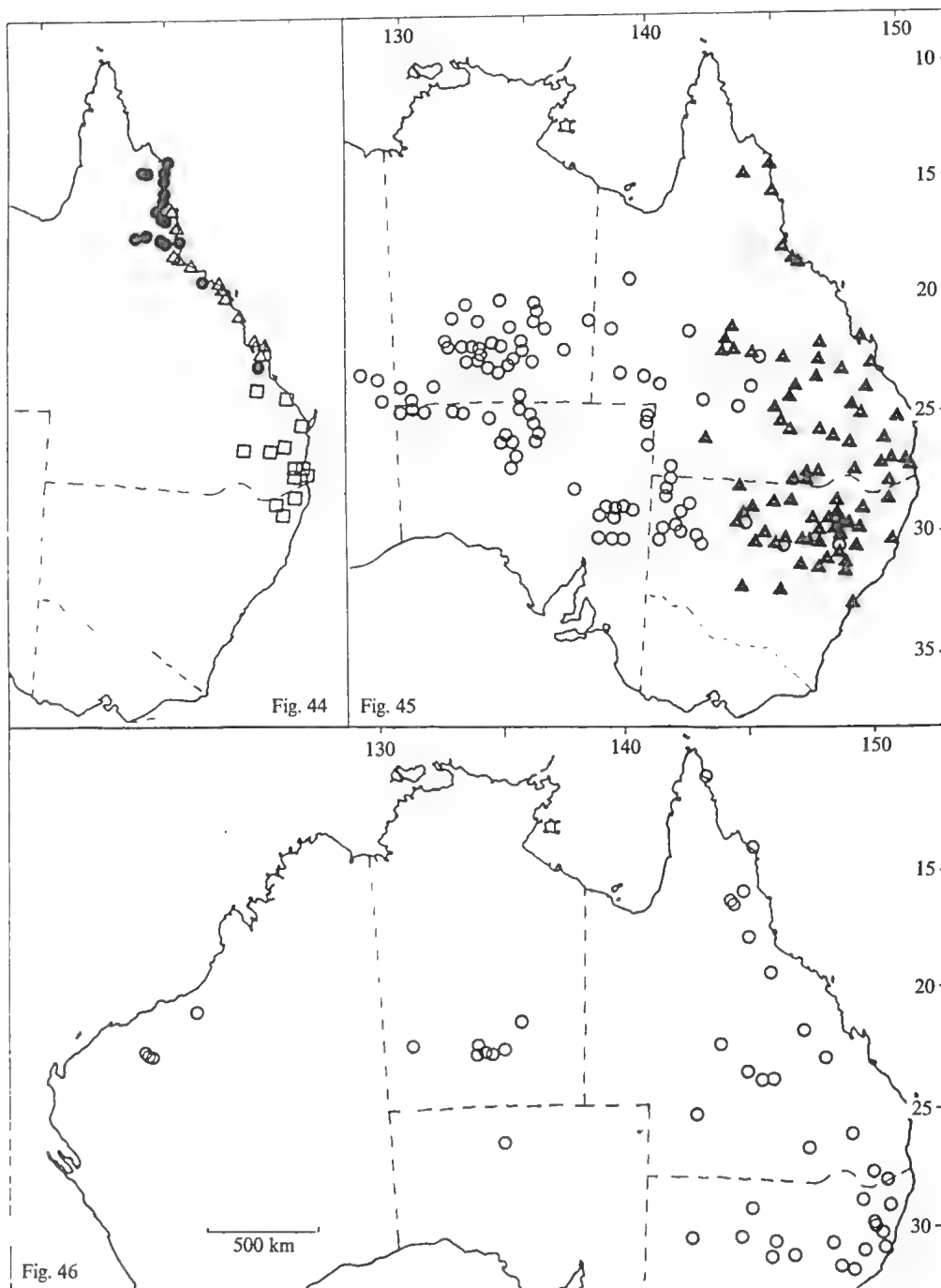


Fig. 44-46. Distribution of *Rostellularia* in Australia. Fig. 44.  $\square$  *R. cf. obtusa*; *R. adscendens* ssp. *adscendens*  $\triangle$  var. *juncea*;  $\bullet$  var. *hispida*. Fig. 45. *R. adscendens* ssp. *adscendens*  $\blacktriangle$  var. *adscendens*;  $\circ$  var. *pogonanthera*. Fig. 46. *R. adscendens* ssp. *adscendens*  $\blacktriangle$  var. *adscendens*;  $\circ$  var. *latifolia*.

### Distribution

*R. adscendens* ssp. *adscendens* var. *hispida*, like var. *juncea*, is confined to eastern coastal Queensland, but in this case the specimens tend to come from areas further north, the most northerly record being in the region of Cooktown. There is overlap of distribution of the two taxa in the Herberton-Watsonville area, and a single more southerly record from the Burdekin River, south of Ayr.

### Ecology

Ecological annotations for specimens of var. *hispida* include "savannah woodland", "open *Eucalyptus* forest" "sandy ridges" and "sandy wallum type country". This last record is interesting in that species from wallum type vegetation often have a woody rootstock and produce only a few stems, a description which fits this taxon extremely well. However, more field observations are needed to clarify the ecological preferences of this taxon. Flowering specimens have been collected in most months of the year.

### Notes

1. There is a group of specimens which have more or less sessile glandular hairs on the petiole and in the furrow of the midrib on the under surface of the leaf. In all other respects they seem to agree with this taxon, but they have been listed separately to draw attention to this characteristic which may be significant.

2. Var. *hispida* is very similar in habit to var. *juncea*, the major difference being flower size, the significance of which is discussed under the species (p. 252). There is often also a difference between the two varieties in the presence of long, stalked, glandular hairs on the bracts in var. *juncea*, but with them lacking in var. *hispida*.

3. For specimens which are intermediate between var. *hispida* and var. *adscendens* see under the latter.

### Specimens examined

QUEENSLAND: *Anon.* 27, s. dat., Nerkool Creek (MEL 101233); *Armit* 55, s. dat. Cashmere (MEL); *Ashby* 829, 1941, Mt Molloy (AD); *Bick* s.n., 1914, Mt Surprise (NSW 151951); *Birch* s.n., 1891, Junction Ck (MEL 101252); *Blake* 23398, 19.v.1970, Annan Gorge, S of Cooktown (BRI, NSW); *Crome* 745, 25.iv.1971, Little Mitchell Creek, 15 m N of Mareeba (CANB); *Chapman* A96, 25.viii.1972, Range between Atherton & Herberton (BRIU); *Clarkson* 4659, 19.iv.1983, Springmount Stn, c. 13 km from Mareeba-Dimbulula Rd on the road to Collins Weir (AD); *Dallachy* s.n., s. dat. Rockingham Bay (MEL 101184); *Darnell-Smith* s.n., iv.1929, Mareeba (NSW 151948); *Dietrich* s.n., viii.1865, Rockhampton (PR); *Dietrich* 1542, 1863-5, Brisbane River (PR); *Dockrill* 362, 30.i.1972, Herberton-Watsonville Rd (QRS); *Domin* 8416 & 8417, ii.1910, prope Mareeba (PR); *Gittins* 523, vi.1962, Stannary Hills (BRI); *Kenny* s.n., 6.i.1912, Herberton (BRI 087851, BRI 141399); *Morain* 227, 2.xi.1967, 7 m N of Wairuna, c. 40 m S of Mt Garnet (BRI, BRIU); *Myers* s.n., 23.xii.1960, St Ronan's Stn, Mt Garnet (BRI 028655); *Scarth-Johnson* 291A, viii.1976, Nr Laura (BRI); *Seton* 25, 28.ii.1963, 40 m S of Ayr on W bank of Burdekin R. (BRI); *Sharpe* 1510, 20.vi.1975, Cape Flattery, c. 70 km N of Cooktown on track to 14 Mile Beach (BRI); *Thorsborne* s.n., 10.iii.1975, c. 16 km S of Cardwell, S of Dampier Creek, c. 0.5 km W of Bruce Highway (BRI); *Thorsborne* 5, 16.ii.1975, same locality as *Thorsborne* s.n., (BRI); *Whitehouse* s.n., 31.v.1962, Junction of Cooloomon & Little Cooloomon Creeks, SW of Herberton (BRI 037973).

WITHOUT SPECIFIC LOCALITY: *Anon.* (?*Dallachy*) s.n., 4.i.1866. (MEL 101232).

### Specimens aff. var. *hispida*

QUEENSLAND: *Anon.* s.n., s. dat., Rockhampton (MEL 101175); *Hubbard & Winders* 7559, 13.ii.1931. Between Mt Emu Plains and Mt Sturgeon Stns, N of Hughenden (BRI); *Schomburgk* s.n., s. dat. Without locality (AD 96307272 p.p.).

### Specimens examined with glands on the petiole (see Note 1)

QUEENSLAND: *Anon.* (*Herb. Flecker*) s.n., 17.iv.1935, 8 m from Dimbulah, Mt Mulligan Railway Line (QRS

023812); *Bancroft* 101, vi.1908, Stannary Hills (BRI); *Clarkson* 4694, 26.iv.1983, Mushroom Rock, 5.3 km E of the Peninsula Development Rd on an IWS track leaving the main road 0.5 km N of the Laura River (AD); *Crome* 670, 23.ii.1971, 5 m N of Mareeba (CANB); *Clarkson* 4713, 26.iv.1983, 3.7 km E of the Peninsula Development Rd on an IWS track leaving the main road 0.5 km N of the Laura River (AD); *Knowlton* 70, 22.xi.1977, 23 Reynolds St, Mareeba (QRS); *Karsten* s.n., ii.1881, Trinity Bay (MEL 100944, MEL 100929); *Keefer* s.n., xii.1957, Parada (BRI 009519); *Thurston* 47, 5.iii.1937, Mareeba (QRS); *Webb & Tracey* 5503, 17.i.1962, ½ m S of Mareeba on Atherton Rd (BRI, CANB).

iv. var. **pogonanthera** (F. Muell.) R.M. Barker, comb. & stat. nov.

*Rostellularia pogonanthera* F. Muell., *Linnaea* 25 (1852) 431, BASIONYM; Bremek., *Acta Bot. Neerl.* 11 (1962) 197; Hj. Eichler, *Suppl. J.M. Black's Fl. S. Austral.* (1965) 284; Beard, *W. Austral. Pl.* (1970) 120; Chippendale, *Proc. Linn. Soc. N.S. Wales* 96: (1971) 259; W.R. Barker, *Fl. Central Austral.* (1981) 337; J. Green, *Census Vasc. Pl. W. Austral.* (1981) 95; Cunningham et al., *Pl. W.N.S. Wales* (1982) 606.

*Lectotype here designated: Mueller s.n.*, x.1851, prope Akaba (MEL 601993); isoelectotypes: (MEL 601992, MEL 601991).

*Justicia procumbens* auctt. non L.: F. Muell., *Fragm. Phyt. Austral.* 6 (1867) 91; Bentham, *Fl. Austral.* 4 (1868) 549 p.p. (as to specimens from S. Austral.); F. Muell., *Fragm. Phyt. Austral.* 11 (1878) 18; F. Muell., *Syst. Census Austral. Pl.* (1882) 99 p.p. (as to Central Australian material only); Tate, *Hdbk Fl. Extratrop. S. Austral.* (1890) 253; F. Muell., *Sec. Syst. Census Austral. Pl.* (1889) 167; Ewart & Davies, *Fl. N. Terr.* (1917) 252 p.p.; Black, *Fl. S. Austral.* 4 (1929) 518; Robertson in Black, *Fl. S. Austral.* 4 (1957) 777.

Decumbent, usually dense, spreading, grey-green or green, densely pubescent or more or less glabrous, perennial herbs or shrubs up to 30 cm high, with small vegetative shoots on basal parts of woody branches. *Branches* many, with fine, white, downcurved, eglandular hairs all over or confined to nodes and young parts, nodes always conspicuously white with hairs. *Leaves* on short petioles 0.5-1 mm long, often obscured by dense white hairs, base broad cuneate, entire, apex acute or obtuse; blade ovate, (4.8-) 5.7-17 (-24) x (1.7-) 3-8.6 mm, 2-3 x longer than broad, white downcurved hairs usually dense, sometimes sparse or absent on upper darker surface, cystoliths small, irregularly orientated to midrib, usually obscured by hairs. *Bracts* 4.5-8 x (0.9-) 1.1-2 mm, lowest in inflorescence often indistinguishable from leaves, covered with same white hairs as the rest of the plant, usually mixed with obscure more or less sessile glands. *Corolla* (6-) 7-10.5 mm long along upper side. *Ovary*: style 5-6 mm long. *Capsule* 6-7.5 mm long. *Seed* 1.5-1.9 mm long. Fig. 42 I-M.

### Distribution

*R. adscendens* ssp. *adscendens* var. *pogonanthera* is found throughout central and eastern arid Australia, the main area being northern South Australia and southern Northern Territory with extensions into neighbouring parts of New South Wales, Queensland and Western Australia (Fig. 45).

### Ecology

The variety is usually found in or near watercourses although there are more rarely records of it from sand plains, where it has been recorded with *Acacia aneura*, *Aristida contorta* and *Enneapogon avenaceus*, and *Eucalyptus terminalis*. It has also been found on heavy clay soil with *Astrebla pectinata* and from soil in rock crevices. It is most commonly collected in flower from July to October with occasional occurrences outside these months.

### Notes

1. There are two forms within this variety intergrading with each other, but at their

extremities relatively distinct. Those plants from the Rawlinson Range of Western Australia, far north-western South Australia and the south-western Northern Territory are usually more densely tomentose all over than those from areas further south or east, which in contrast often appear almost glabrous while usually still retaining the distinctly white hairy nodes. The "glabrous" form grades into var. *adscendens* but differs from it in the shorter leaves, only 2-3 compared with 3-6 times longer than broad. There is also often a flower size difference with those of the "hairy" form tending to be larger, 8-10 mm long along the upper surface compared with (6-) 7-8 mm long. However, occasional New South Wales and Queensland populations have the larger flowers. It should be noted that flowers of the syntypes from the Flinders Ranges of South Australia are in the smaller 7-8 mm range, but in vestiture the specimens are more allied to the tomentose form from further north.

2. Within the overlap area of var. *adscendens* and var. *pogonantha* in New South Wales and Queensland it is sometimes extremely difficult to assign specimens to either taxon. A list of such specimens is given after those of var. *pogonantha*.

*Representative specimens examined* (c. 201 specimens seen).

NEW SOUTH WALES: *Donner* 5623, 7.v.1977, Depot Glen. Ck nr Mt Poole Stn (AD); *Harding* s.n., 16.ix.1966, Edwards Lookout, c. 9 m from Broken Hill, nr Stephens Ck Reservoir (AD 96646183); *Martensz* 1549, 31.iii.1967, Quarry View Stn (CANB, NSW).

NORTHERN TERRITORY: *R.M. Barker* 146, 16.iv.1983, Burt Plain, 56.3 km N of Alice Springs on Stuart Hwy (AD); *Chippendale* s.n., 7.v.1955, 18 m E Plenty R., Jervois Stock Route (BRI 022079, NT 1112, CANB 74438, NSW); *Cleland* s.n., 18.viii.1931, Cockatoo Ck, c. 255 km NW of Alice Springs (AD 96306075, AD 96306070); *Latz* 4462, 21.ix.1973, Palm Valley (NT); *Lazarides* 5218, 8.v.1955, 44 m SW of Lucy Creek Stn (AD, BR, CANB: 2 sheets, MEL, NT, NSW); *Maconochie* 89, 7.iv.1967, 13 m S Hamilton Downs (AD, CANB, MEL, NSW, NT); *Willis* s.n., 23.vii.1966, North foot of Mt Liebig, 269 km W of Alice Springs (MEL 101153).

QUEENSLAND: *W.R. Barker* 2685, 5.viii.1978, Gidya Creek crossing by main Windorah-Bedourie Road, c. 37 km by road W of Currawilla (AD); *Everist* 3810, 28.v.1949, Malven Hills, c. 25 m W of Blackall (BRI); *Lavery* 96, 20.i.1958, Leichhardt R., 12 m N of Mt Isa (BRI).

SOUTH AUSTRALIA: *Donner* 6549, 4.ix.1978, Creek, c. 2.5 km NW of Mt Davies camp (AD); *Filson* 3399, 2.x.1960, Creek bed 5 miles N of Cordillo Downs (AD); *Mueller* s.n., x.1851, prope Akaba (MEL 601991, MEL 601992, MEL 601993); *Stove* 497, 6.ix.1978, c. ¾ km W of road to Waltjijata, c. 6½ km by road NNE of turnoff from Pipalyatjara to Putaputa road, Tomkinson Range (AD); *Symon* 9130, 19.ix.1974, N of Oodnadatta, 4.8-6.4 km N of Mt Alexander (ADW); *Whibley* 2605, 23.viii.1968, Paralana Springs, c. 125 km NE of Blinman (AD); *Whibley* s.n., 23.ix.1956, Gammon Ranges, Arcoona Ck Gorge, S of Gammon Hill (c. 8 km E of Owieandana Hut) (AD 95733015).

WESTERN AUSTRALIA: *George* 5239, 21.vii.1963, Mt Aloysius, E of Blackstone Range (PERTH); *Kuchel* 193, 2.viii.1962, Warrabri Gorge, SW side of Rawlinson Range (AD); *Lay* 866, 29.viii.1973, Fanny's Pk, 85 km S of Giles Meteorological Stn, on Warburton Rd (AD); *Wilson* 2396, 3.viii.1962, Pass of the Abencerrages, Rawlinson R (AD, CANB).

SPECIMEN OF DOUBTFUL LOCALITY: *A. Black* (*Herb. J.M. Black*) s.n., xi.1947, Victor Harbour, (AD 96307260 p.p.) (Locality doubtful, resembles some of the more glabrous collections from the Flinders Ranges in South Australia, possibly cultivated).

*Specimens intermediate between var. adscendens and var. pogonantha*

The majority of the following specimens have leaves which resemble var. *pogonantha* in length being slightly less than 3 times longer than broad, but approach var. *adscendens* in lacking hairy internodes.

NEW SOUTH WALES: *Anon* s.n., s. dat. Castlereagh's River (MEL 101241, MEL 101226); *Charsley* s.n., 1886, Near Silverton (MEL 100925); *Briggs* 2686, 18.v.1969, 37 m W of Nyngan on Barrier Hwy (NSW); *Howard* s.n., 25.xii.1962, 36 m N of Nyngan (ADW 34710); *Irvine* s.n., viii.1889, Near Silverton (MEL 100909); *Maiden* s.n., v.1913, Nyngan (NSW 151920); *Moore* 5621, 6.xi.1969, 'Tundulya' — c. 25 m SE of Louth (CANB); *Moore* 5731, 9.iii.1971, Near Boppy Mt, 25 m E of Cobar (CANB); *Moore* 5760, 17.iv.1971, 'Tundulya' (CANB); *Moore* 7593, 6.iv.1978 24.5 km from Boppy Mt on road to Girilambone (CANB: 2 sheets); *Murray* s.n., s. dat. between the Bogan and the Lachlan (MEL 101220).

QUEENSLAND: *Anon*. 5, 1891, Widorah (MEL); *Spencer* s.n., 1885, E of Thargomindah, between the Bulloo and Paroo River (MEL 100936).

v. var. *latifolia* (Domin) R.M. Barker, comb. nov.

*Justicia procumbens* var. *latifolia* Domin, Biblioth. Bot. 89 (1929) 604, BASIONYM.

*Lectotype here designated: Domin 8410*, ii.1910, In colle arenso Smelling Bluff, prope opp. Chillagoe (PR); syntype and probably isoelectotype: *Domin 8418*, annotated as prior specimen (PR).

*Rostellularia* sp.: W.R. Barker, Fl. Central Austral. (1981) 337.

Small herbs c. 10 cm high to sparse or dense shrubs to 30 (-40) cm high, decumbent, simple branches dichotomising in upper parts. *Branches* with small cystoliths in green longitudinal furrows, downturned hairs along ribs between or hairy all over, particularly dense at nodes and young parts, sometimes obscuring cystoliths, hairs long and stout (in Queensland) or lax and slender (in central and western Australia). *Leaves* on short and broad petioles 0.5-1.5 mm long, base narrow- to broad-cuneate, entire or somewhat crenulate, apex acute, more rarely obtuse; usually broadly ovate, 4.5-9.7 x 2.3-5.8 mm (central Australia), sometimes longer and more narrowly ovate (6.3-15 x 2-4 mm) (Queensland areas), lax, slender, downturned white hairs usually on both surfaces, sometimes lacking from darker (rarely purple) upper surface, lower surface pale green, sometimes hispid all over, inconspicuous cystoliths on margins of upper surface more or less perpendicular to midrib, others more or less irregularly arranged. *Bracts* 3.2-5.5 x 0.7-1.4 mm, cystoliths parallel to midrib, eglandular hairs densely lining margin and midrib, sometimes sparse on non-hyaline green (or purple) portion of bract, glandular hairs usually borne on non-hyaline parts. *Corolla* 4-6 (-7) mm long along upper side. *Ovary*: style 3.2-5 mm long. *Capsule* (3.2-) 4.5-6 (-6.5) mm long. *Seed* 0.9-1.5 mm long.

### Distribution

*R. adscendens* ssp. *adscendens* var. *latifolia* has a disjunct range across northern Australia. One area covers the eastern coast of Australia between New England in New South Wales and Cape York in Queensland, a second area occurs chiefly around the MacDonnell Ranges and surrounding regions of the Northern Territory; a third area is in the Pilbara region of Western Australia from Wittenoom to the Oakover River. Fig. 46.

### Ecology

The collections from around Alice Springs and the MacDonnell Ranges all come from rocky sites, particularly in crevices, gullies and in two cases from a sandy watercourse amongst rocks. The Western Australian specimens are from alluvial ironstone soil (Wittenoom) and from rocky hills (Oakover River). A collection from north-western New South Wales (*Milthorpe 571*) is from sandy soil in a creek bed, but the New England collections bear no ecological annotations.

### Notes

1. Plants of the small flowered var. *hispidula* growing in the same area as the larger-flowered variety are often vegetatively indistinguishable from one another. Thus, the Western Australian and central Australian small-flowered plants are similar to var. *pogonantha* in habit, narrower-leaved plants from Queensland tend to resemble var. *adscendens*, and the broader-leaved specimens approach ssp. *dallachyi* (see Note 3). There may be reason to recognise these as distinct varieties as has been done with var. *juncea* and var. *hispidula*, but the relative paucity of small-flowered populations (except from the MacDonnell Ranges) compared with large-flowered populations makes me reluctant to take this step at present. The



plants appear to occur in distinct populations of entirely small-flowered individuals, or entirely large-flowered ones within central Australia where the large-flowered "hairy" form of var. *pogonanthera* (q.v., Note 1) has the upper side of the corolla greater than 8 mm long; the small-flowered plants of var. *latifolia* have a corolla length of 4-6 mm. In the majority of cases the larger-flowered variety is also densely covered with white hairs, while the small-flowered variety is much less pubescent. There are a few specimens where this distinction breaks down and these have the indumentum and habit of var. *pogonanthera* and the smaller flowers of var. *latifolia* (see after specimens examined).

2. The New England collections are possibly distinct enough from other varieties in habit and small size to deserve recognition. However, var. *latifolia* should be regarded as a temporary grouping of specimens until more is known about their relationship with the larger-flowered varieties.

3. In Queensland, those collections of var. *latifolia* which have broadly ovate leaves approach ssp. *dallachyi* in habit, but differ from it in being densely hispid all over. For example, the flowers on the collection *Clarkson 4672* are slightly larger than normal (7 mm along the upper side of the corolla) but it remains distinct from ssp. *dallachyi*, the only other broad-leaved, petiolate taxon in the area, by its hispid parts.

#### *Representative specimens examined* (85 specimens seen)

NEW SOUTH WALES: *Beckler s.n.*, s. dat. Hastings River (MEL 101197, MEL 101238); *Beckler s.n.*, s. dat. Clarence River (MEL 101235); *Beckler s.n.*, s. dat. McLeay River (MEL 101185); *Cleland s.n.*, 23.iv.1912, Grafton (AD 97013011); *Davis 96*, 31.i.1941, Wollomombi Falls, 26 m NE of Armidale (NSW); *Hutchinson s.n.*, 1889, Nyngan (MEL 100920); *McPherson 109*, 1889, Bogan (MEL); *Stuart 218*, s. dat. New England (MEL — 2 sheets); *K.L. Wilson 1305*, 28.iii.1975, 'Iolanthe', 26 km W of Garah (NSW).

NORTHERN TERRITORY: *W.R. Barker 2832*, 21.viii.1978, MacDonnell Ranges: c. 7 km by road from Iwupataka on (old) road to Standley Chasm (AD); *R.M. Barker 145 & K. Wilson*, 15.iv.1983, NNE and NNW slopes of Spencer Hill, Alice Springs (AD); *Chippendale s.n.*, 30.vii.1954, Billy Goat Hill, Alice Springs (NT 112); *Chippendale s.n.*, 9.xi.1954, Bitter Springs, 59 m E of Alice Springs (NT 459); *Ising s.n.*, 30.viii.1933, MacDonald Stn (225 km NE of Alice Springs) (AD 966021257); *Kalotas 705*, 29.viii.1980, Anna's Reserve, Aileron (NT).

QUEENSLAND: *Bailey s.n.*, vi.1892, Charters Towers (NSW 151945); *Biddulph s.n.*, 1890, Mt Playfair, Tambo (MEL 101266); *Conn 1313 & De Campo*, 2.vi.1983, Griffith Siding, c. 4 km by road E of Mungana which is c. 10 km W of Chillagoe (MEL); *Crisp 2999*, 12.vi.1977, Expedition Range, Blackdown Tableland, Stony Creek Falls (CBG); *Cull s.n.*, 23.v.1961, 1 m past Blackall Wool Scour on roadside (BRI 030830); *Domin 8410 & 8418*, ii.1910, Smelling Bluff dicto prope opp. Chillagoe (PR); *Everist & White 105*, 28.v.1936, c. 10 m NW of Longreach (BRI); *Flecker s.n.*, 28.iv.1935, Mt Mulligan (QRS 023816).

SOUTH AUSTRALIA: *R.M. Barker 122*, 12.iv.1983, South branch of the Neales, c. 71 km from turnoff on to Hawks Nest Well Road which is c. 2 km W of Oodnadatta (AD).

WESTERN AUSTRALIA: *Beard 4005*, 6.v.1965, Warrawagine Stn, Oakover Beds (PERTH, KINGS PARK, NSW); *Beaglehole 11541*, 16.viii.1965, 9 m E of Wittenoom (PERTH); *Blockley 179*, 2.v.1966, Middle Creek area, Wittenoom Gorge (KINGS PARK, PERTH); *Blockley 206*, 23.v.1966, Kalamina Gorge, Wittenoom area (KINGS PARK, PERTH).

#### Specimens intermediate between var. *latifolia* and var. *pogonanthera*

NORTHERN TERRITORY: *Gardner 11560*, 8.iii.1953, MacDonnell Range (PERTH, MEL); *Hill 210*, 26.v.1911, Haast's Bluff, MacDonnell Ranges (MEL); *Perry 3356*, 8.iii.1953, Alice Springs (CANB — 2 sheets).

b. ssp. *clementii* (Domin) R.M. Barker, comb. & stat. nov.

*J. clementii* Domin, Biblioth. Bot. 89 (1929) 605, BASIONYM.

*Possible holotype*: *Clement s.n.*, s. dat., inter Ashburton et De Gray River (PR 531032).

*Justicia media* R. Br., Prodr. (1810) 476: (Robert Brown's collection comes closest to ssp. *clementii* but also approaches

ssp. *adscendens*: see Typification). Possible holotype: R. Brown 2947, 4.i.1803, Carpentaria [Mainland opposite Groote Island]. (BM).

*Justicia diffusa* auct. non Willd.: Gardner, Enum. Pl. Austral. Occid. (1930) 119; Beard, W. Austral. Pl. (1965) 98, (1970) 119.

*Rostellularia diffusa* auct. non (Willd.) Nees: J. Green, Census Vasc. Pl. W. Austral. (1981) 95.

Erect or decumbent, spreading, ? annual herb to 40 cm tall, not glaucous. *Branches* constricted above nodes, glabrous or eglandular hairy, 6-angled, sometimes red to purple, with or without small cystoliths parallel to main axis. *Leaves* with slender 1-7 mm long petioles, base attenuate, entire, apex obtuse; blade narrow-linear to ovate, usually glabrous apart from few sparse hairs on margin, cystoliths towards middle of upper surface curved and at slight angle to midrib, those on margin more or less perpendicular to midrib. *Inflorescence* a dense terminal spike, or terminal on short axillary branches. *Bracts* lanceolate, base attenuate, apex usually acuminate, more rarely (Queensland) acute, conspicuous white margin 0.35-0.5 mm wide at broadest point  $\frac{1}{2}$ - $\frac{3}{4}$  from base, lined with eglandular hairs, usually with small sessile or stalked glands densely all over green section of bract, sometimes (var. *largiflorens*) lacking them, rarely (Queensland) with few eglandular hairs on external surface of bract including hyaline part. *Bracteole* narrower, otherwise similar to bract. *Calyx* segments more or less linear, equalling or shorter than bracts and bracteoles. *Corolla* with white upper lip, purple to mauve lower lip, white areas on palate, glabrous externally except on middle lobe of lower lip. *Capsule* pubescent only at acuminate portion of apex, rarely glabrous all over. Fig. 42 C-F.

### Typification

#### 1. *Justicia clementii* Domin

The type collection contains a number of glabrous capsules. Such a character is unusual for this taxon. Even collections from the same area possess capsules which are pubescent at the apex. In other respects, however, it agrees well. There is certainly no justification for segregating this collection from allied material on the basis of a single character.

#### 2. *J. media* R. Br.

Within Brown's unpublished manuscript there is no mention of *J. media*. Instead it appears that he decided that a collection which he had originally referred to "*J. juncea*", was sufficiently distinct to deserve specific status. The specimen in BM bears the annotation '*J. juncea* Prodr. 476' with the epithet crossed out and replaced by '*media* Prodr. 476'. The type comes closest to *R. adscendens* ssp. *clementii*, but as with a number of collections from Queensland (see Note 2) shows some approach to ssp. *adscendens*.

### Distribution

*R. adscendens* ssp. *clementii* is distributed across the whole of northern Australia, chiefly between latitudes 15 and 23 degrees, but with a widely disjunct location at Pandie Pandie in north-eastern South Australia. The subspecies is divisible into two varieties.

*Ecology*: see varieties.

### Notes

1. Ssp. *clementii* is distinguished by its bracts. The hyaline margin is widest in the upper half as opposed to all other taxa of *Rostellularia adscendens* where it is widest in the lower half of the bract (Fig. 42). The usually dense cover of glandular hairs on the green portion of the bract is also diagnostic of the subspecies, although these are sometimes completely lacking in one of the two varieties, var. *largiflorens*. The bract margins are frequently ciliate.

Within this subspecies, as with other subspecies of *R. adscendens*, there is a range in flower size. The large and small flowered populations have been recognised as varieties as they show a geographical separation. As in ssp. *adscendens*, the variation appears to be clinal with the large-flowered, less robust herbs of Arnhem Land and environs becoming progressively smaller-flowered and more robust with occurrence in drier areas. The inconspicuous flowers of the drier areas (3.5-4 mm along the upper surface) are in marked contrast to the larger flowers of Arnhem Land (8-9 mm along the upper surface), but as in other taxa of *R. adscendens* whether there is an associated pollinator difference is not known (see *R. adscendens* Note 2). Difficulties will be encountered in determining specimens to varietal level when they are found in areas of overlap of the two taxa. A list of such specimens is included after var. *clementii*.

Other character differences occur between the two varieties of ssp. *clementii* which are more difficult to express in comparative terms. For example, dried specimens of collections of var. *clementii* are always pale green in colour while those of var. *largiflorens* are dark green in colour; the white hyaline margin of the bracts is particularly noticeable in var. *clementii*, but not so obvious in var. *largiflorens* where the white ciliate hairs of the upper bract are more conspicuous: they are sparser and inconspicuous in var. *clementii*.

2. In Queensland where the subspecies is represented by the small-flowered var. *clementii*, there is a tendency for the lower bracts of a spike to be narrower than in specimens from the western part of the distribution, for the apex not to be cuspidate but acute, and for there to be a few hairs on the outer surface, particularly the hyaline area. While these characters approach ssp. *adscendens*, the specimens are usually easily identified by their longer-petioles, the nodes with 3-5 branches arising from them, their crowded bent inflorescences and their tiny flowers. In addition it is also found that those bracts nearest the apex of the spike are more typical of ssp. *clementii* in often possessing glandular hairs, while the lower bracts are without them.

The collection, *McRay s.n.*, appears to be an exception. It possesses the bracts of ssp. *adscendens* with no resemblance at all to ssp. *clementii*. However the only flowers present are tiny and glabrous and correspond with var. *clementii*. This was the only collection seen which indicated an intergrade between the two subspecies ssp. *adscendens* and ssp. *clementii*, the overall relationships of which are discussed in Note 2 under the species.

### Key to varieties of ssp. *clementii*

- 1a. Corolla 3.5-5 (-6.5) mm long along upper side. Style 2.2-4 mm long. Inflorescence 1, 2 or 3 terminal spikes on each main branch. Bracts with central pale green portion covered by dense glandular hairs, the conspicuous hyaline margin sparsely and obscurely ciliate in distal part ..... i. var. *clementii*
- 1b. Corolla 6.5-9 mm long along upper side. Style 5-5.5 mm long. Inflorescence a single erect terminal spike on each main branch. Bracts with central dark green portion with or without glandular hairs, the inconspicuous hyaline margin distinctly ciliate ..... ii. var. *largiflorens*

i. var. *clementii* (Domin) R.M. Barker, comb. & stat. nov.

*Justica clementii* Domin, Biblioth. Bot. 89 (1929) 605, BASIONYM.

Possible holotype: *Clement s.n.*, s. dat. inter Ashburton et De Gray River (PR531032).

Decumbent herb with 2-5 simple, often stiff branches arising at least at some nodes. Branches glabrous. Leaves 1-4.5 x 0.4-1 cm, rarely (*Fitzgerald 462*) 6 x 0.3 cm. Inflorescence with 1-2-3 terminal spikes on each main branch, spikes often bent in lower part. Bracts 5-8.5 x 1.2-1.6 mm, midrib sometimes with short eglandular hairs, central pale green portion with dense, sometimes more or less sessile glandular hairs, rarely (Queensland) mixed with few eglandular hairs; conspicuous hyaline margin sparsely and obscurely eglandular-ciliate. Corolla 3.5-5 (-6.5) mm long along upper side. Ovary: style 2.2-3.8 mm long. Fig. 42 C-F.

## Distribution

*R. adscendens* ssp. *clementii* var. *clementii* is the most widespread of the two varieties of ssp. *clementii*. It is extremely common throughout its range across the top of Australia between latitudes 15 and 24 degrees, Fig. 47.

## Ecology

The variety has been recorded from grassland (dominants including Mitchell grass or *Themeda australis*), usually with scattered trees, from alluvial flats or depressions (in one case associated with *Ophiuros* sp. and *Eulalia fulva* and another with *Eucalyptus pruinosa*) from a ridge with stunted *Acacia georginae*, and from a burnt spinifex plain. It has also been noted as a weed of sorghum cultivation. Soils vary widely and include black cracking clay, self mulching grey-brown clay, yellow loam with outcrops and numerous fragments of chalcedony and common opal and sand. Var. *clementii* is apparently abundant after rain and has been suspected of poisoning stock. Flowering specimens have most commonly been collected from March to July, but there are records outside these months.

## Representative specimens examined (c. 89 specimens seen)

NORTHERN TERRITORY: *R.M. Barker* 543, 11.v.1983, 27.5 km E of Daly Waters along Carpentaria Hwy (AD); *R.M. Barker* 206, 21.iv.1983, Armstrong River, 8 km S of Top Springs on road to Wave Hill (AD); *Maconochie* 2006, 8.vi.1974, 1 km E of Fish River Homestead gorge (CANB, DNA, NT); *Must* 1541, 27.vi.1977, McArthur River Crossing, Borroloola (BRI, CANB, DNA); *Perry* 558, 24.iv.1948, 9 m NE of Tennant Creek Township (CANB: 2 sheets, BRI, NT, NSW); *Perry* 2080, 6.vi.1949, 46 m SW of Birrimbah Outstation (CANB); *Pullen* 9353, 22.v.1974, Flying Fox Creek between "Mainoru" and "Beswick Stations" (CANB).

QUEENSLAND: *W.R. Barker* 2692, 5.viii.1978, Hamilton River Channel complex, c. 32 km by road S of Mudgeacca Homestead (AD); *R.M. Barker* 611, 17.v.1983, 21 km S of Mt Isa on Duchess Rd (AD); *Davidson* 127, v.1952, 34 m NW of Longreach (BRI, BRIU); *Henderson et al* 780, 23.iv.1971, Blackdown Tableland, c. 32 km SE of Blackwater (BRI p.p., MEL, NSW); *Kearney s.n.*, s. dat. Selferino Station, Clermont (BRI 142224); *Morton* 1165, 22.iii.1981, Weipa. Downstream from Hey/Franjum Point on Embley River (MEL); *Ollerenshaw* 1332 & *Kratzing*, 11.vii.1974, c. 53 km NE of Lawn Hill on road to Doomadgee (BRI, NT); *Pearson* 164, 27.iii.1943, Hughenden, Cameron Downs (BRI); *Tindale s.n.*, 29.v.1963, Mornington Island (AD 97807504).

SOUTH AUSTRALIA: *Cleland s.n.*, 18.viii.1934, Diamantina at Pandie Pandie (AD 97119182, AD 96307258 p.p.).

WESTERN AUSTRALIA: *Blockley* 293, 2.vii.1966, Fortescue. Marra-Mambu area (KINGS PARK); *Burbidge* 946, 6.vi.1941, De Gray, Muccan (PERTH); *George* 3512, 3.iii.1962, Fortescue River at Millstream (PERTH); *Jackson* 1010, 28.v.1967, Margaret River, c. 20 km E of Fitzroy Crossing (AD); *Pajmans* 2593, 21.iii.1978, Ord River plain, 35 km E of Wyndham (CANB).

## Specimens of var. *clementii* approaching var. *largiflorens* (Note 1).

NORTHERN TERRITORY: *R.M. Barker* 315, 27.iv.1983, 14.4 km along Top Springs-Katherine Rd from Victoria Hwy (AD); *R.M. Barker* 579, 14.v.1983, McArthur R. Crossing, 4 km E of Borroloola (AD); *Byrnes* 2204, 19.v.1971, Big Horse Ck, Victoria River (CANB, DNA, NT); *Holtze* 33, 1894, Powells Creek (MEL); *Holtze* 1388, 1897, Powells Creek (MEL); *Maconochie* 1757, 19.vii.1973, Sturts Creek, N of Birrinbu (NT); *Tulloch* NW 27, 8.iv.1964, Elliot (DNA).

QUEENSLAND: *Dittrich s.n.*, 1886, From Herbert River to Carpentaria (MEL 100931); *de Lestang* 103, 28.ii.1946, Adel's Grove (QRS).

WESTERN AUSTRALIA: *Black* 16A, 29.ii.1972, Kununurra (PERTH); *Broadbent* 622, 28.i.1953, Mt Anderson, Bloodwood Creek (PERTH); *Broadbent* 579, 14.i.1953, Liveringa (PERTH); *Gardner* 9846, 22.i.1951, Carlton Hills Station (PERTH).

## Intergrade between ssp. *clementii* and ssp. *adscendens*

QUEENSLAND: *McCray s.n.*, 17.v.1973, McKinlay-Hamilton Rd, 7 m past Beaudesert turnoff (BRI).

## ii. var. *largiflorens* R.M. Barker, var. nov.

*Justicia procumbens* auct. non L.: Ewart & Davies, Fl. N. Terr. (1917) 252 p.p. (only as to Hill collections from Borroloola and Okey Ck.)

Varietas nova ssp. *clementii*, a var. *clementio* differt floribus maioribus, 6.5-9 mm secus paginam superam corollae, et stylis longioribus.

*Holotype*: Byrnes 1270, 9.i.1969, 8 miles E Pine Creek (NT); *isotype*: (BRI).

Decumbent, few-branched ?perennial herb, 20-30 cm high, sometimes rooting at nodes on prostrate parts. *Branches* more or less glabrous, or hairs in longitudinal lines, rarely hairy all over. *Leaves* 1.7-4.7 x 0.3-1.1 cm. *Inflorescence* a single erect terminal spike. *Bracts* 5-7 x 1.1-1.8 mm, central portion dark green, sometimes glandular hairy, obscure hyaline margin conspicuously ciliate with eglandular hairs, these sometimes present on midrib of bract. *Corolla* 6.5-9 mm long along upper side. *Ovary*: style 5-5.5 mm long.

### Distribution

*R. adscendens* ssp. *clementii* var. *largiflorens* is restricted to far north Australia with collections from around Darwin, Borroloola and Roper River in the Northern Territory and isolated collections from Glencoe Station, Queensland and the Kimberley Research Station, Western Australia. Fig. 47.

### Ecology

Most specimens have been collected from near creeks or levees, one being from within savannah woodland and another from granitic soil. Flowering specimens have been collected from October to May.

### Note

There are two collections, one from the Northern Territory and one from Western Australia which approach most closely var. *largiflorens*. The Western Australian collection, *Kenneally* 7988, by the shape of its bracts and flower size agrees with var. *largiflorens*. However, the stem and leaves of the specimen have long lax white eglandular hairs visible to the naked eye. The nature of the hairs is similar to that found in other varieties of *R. adscendens* ssp. *adscendens*, namely var. *adscendens* in Queensland and the small-flowered var. *latifolia* from Wittenoom. The only other collection that approaches this in habit is that of

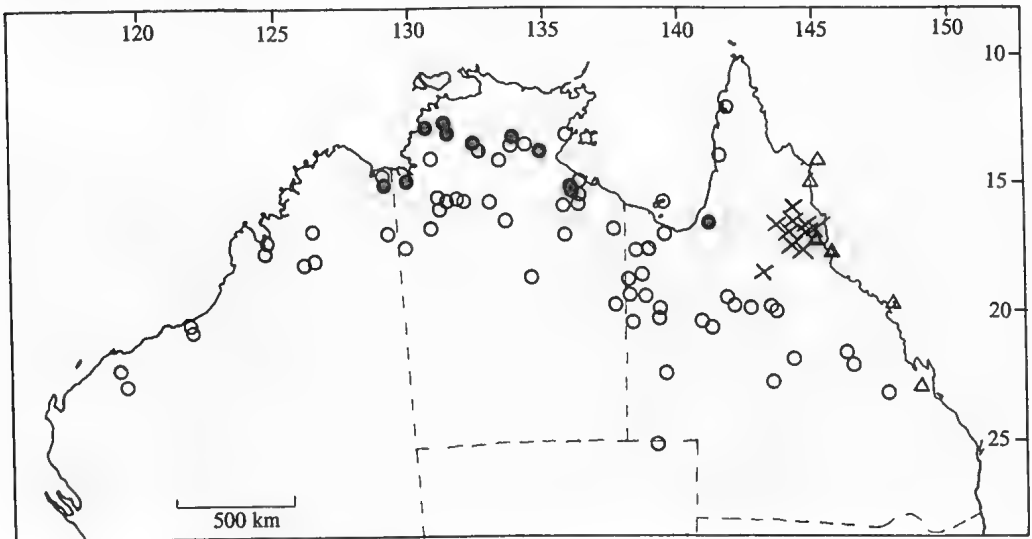


Fig. 47. Distribution of subspecies of *Rostellularia adscendens* (× ssp. *glaucoviolacea*; ○ ssp. *clementii* var. *clementii*; ● ssp. *clementii* var. *largiflorens*; ▲ ssp. *dallachyi*; △ aff. ssp. *dallachyi*.)

*Craven 3852* from McArthur River, but this is not quite so noticeably hairy. In both specimens the leaves are much narrower than is usual for var. *largiflorens*. The Craven collection is from stony hills in eucalypt woodland while the Kenneally collection is from "fissures of lateritic scree . . . in *Eucalyptus miniata*/*Livistona* forest". Only further collections from these areas can resolve the status of the specimens.

### *Specimens examined*

NORTHERN TERRITORY: *R.M. Barker 246*, 22.iv.1983, 114 km W of Timber Ck on Victoria Hwy (AD); *Gunn J*, 24.x.1971, 12 miles from Stuart Highway along Edith Falls Rd (CANB, NT); *Hill 695*, 16.xii.1911, 5 mile Bar, Borroloola (MEL); *Hill 760*, 16.ii.1912, Okey Ck (MEL); *Leske 46*, 23.ii.1960, Roper R. Mission — S of road near Walarai Creek crossing (AD); *Robinson 245*, 16.i.1964, Between Douglas block and River (NT); *Robinson 370*, 8.v.1964, Elliott Ck levee, 6 m NW O. Litchfield Homestead (DNA); *Swinbourne 649*, 23.ii.1963, Airstrip, Mountain Valley Station (CANB, NSW, NT); *Tate s.n.*, 1882, Cynanchum, 12 mile McKinlay (MEL 101264: probably duplicate of next specimen, AD 96244104); *Tate s.n.*, s. dat. 12 Mile Camp [?Noonamah railway siding, c. 20 km from Darwin] (AD 96244104).

QUEENSLAND: *Holtze 1368*, 1892, Glencoe Station (MEL).

WESTERN AUSTRALIA: *Langfield 251*, 30.i.1952, Kimberley Research Station (CANB).

### Specimens examined aff. var. *largiflorens*

NORTHERN TERRITORY: *Craven 3852*, 12.ii.1976, McArthur River area. Near Batten Creek, c. 10 km along the Ryan Bend Waterhole road from the main road (CANB).

WESTERN AUSTRALIA: *Kenneally 7988*, 26.i.1982, Camp Creek, near bauxite crusher, Mitchell Plateau (PERTH).

c. ssp. *glaucoviolacea* (Domin) R.M. Barker, comb. & stat. nov.

*Justicia glaucoviolacea* Domin, Biblioth. Bot. 89 (1929) 605 as "*glauco-violacea*", BASIONYM.

*Lectotype here designated: Domin 8421*, ii.1910, Apud fl. Walsh prope Chillagoe (PR); *other syntypes and possible isoelectotypes: Domin 8422*, ii.1910, Inter opp. Chillagoe et fl. Walsh River (PR); *Domin 3126*, ii.1910, Apud fl., Walsh River (PR).

*Rostellularia simplex* auct. non Wight: F.M. Bailey, Qld Ag. J. 4 (1899) 464; F.M. Bailey, Qld Fl. 4 (1901) 1151: cited as a synonym of *J. notha* Clarke but as not synonymous with *J. simplex* D. Don.

*Justicia notha* auct. non Clarke: F.M. Bailey, Qld Ag. J. 4 (1899) 464; F.M. Bailey, Qld Fl. 4 (1901) 1151; F.M. Bailey, Compr. Cat. Qld Pl. (1913) 374.

Erect, ?perennial herb to 50 cm high, often glaucous. *Branches* simple, rigid, furrowed, glabrous, densely beset with small cystoliths, usually contracted below node. *Leaves* sessile, elliptic to ovate, 2.5-7 x 0.3-1.7 cm, base obtuse or auriculate, entire, acute to acuminate at apex, rarely cuspidate, drying dark green to black, completely glabrous, upper surface densely beset with conspicuous, large, curved cystoliths, all perpendicular to midrib. *Bracts* ovate, 4-6.2 x 1.3-1.7 mm, dark green to black, glabrous apart from few eglandular hairs on apical margin, cystoliths parallel to midrib over both sides, narrow hyaline margin (inconspicuous), widest in lower half. *Bracteoles* similar to bract, 3.5-7.2 x 1-1.2 mm. *Calyx* segments longer than bract and bracteoles, glabrous. *Corolla* white, cream, pale pink or mauve, purple markings in throat, externally hairy, (7-) 8-10 mm long along upper side. *Ovary*: style 5-7 mm long. *Capsule* 4-8 mm long, glabrous. Fig. 42 G.

### *Distribution*

*R. adscendens* ssp. *glaucoviolacea* is confined to the Herberton region of north-east Queensland (Fig. 47).

## Ecology

Ecological annotations on specimens include open forest, an association with yellow jack and bloodwood (both *Eucalyptus* species) and from *Eucalyptus crebra* woodland with *E. polycarpa*. There is a single collection from a ploughed fire break. Altitudinal records are in the range 500-1050 m. Flowering seems to occur between December and June.

## Notes

1. Ssp. *glaucoviolacea* is distinct by its sessile and often auriculate, elliptic to ovate leaves which are frequently glaucous. The whole plant often dries an extremely dark colour. The markings of the flower may also be different to those found in other taxa of *R. adscendens*, but confirmation of this is required. If they are sufficiently different, this may support reinstating the subspecies to its former specific level.

2. Ssp. *glaucoviolacea* is a relatively well defined taxon. However, in areas adjacent to its main distribution in north-east Queensland, there are a series of collections which approach it in their glabrous capsules, bracteoles and calyces, but diverge in other traits. *Mueller MEL 101239* from Burdekin and *Birch BRIU 53296* from Charters Towers agree in most respects with the description of the taxon but differ in the possession of smaller flowers and more narrow, linear leaves. As such they are possibly better placed either in ssp. *adscendens* var. *hispida* or as a small flowered form of ssp. *glaucoviolacea*. Further support for a small flowered taxon of ssp. *glaucoviolacea* is given by *Morain 144* from the Oak Hills area, south of Mt Garnett. At 7 mm long along the upper side, the flowers in this collection are of similar size to those in the Mueller and Birch collections and the leaves are similarly very narrow. *Staples 2204* from Lizard Island also has flowers of similar size and has most attributes of ssp. *glaucoviolacea*, but differs in the very shortly petiolate leaves and hairy calyces. These collections have been referred to as 'aff. ssp. *glaucoviolacea*' and are listed below.

## Specimens examined

QUEENSLAND: *Bancroft 120*, s. dat. Stannary Hills (BRI); *Bennett s.n.*, iv.1889, Irvinebank (BRI 142217); *Burton s.n.*, s. dat. Herberton (BRI 142221); *Clarkson 162*, 14.v.1975, Boomerang Stn, c. 10 km S of Mt Surprise turnoff on Kennedy Highway (BRI, QRS); *Clarkson 4609*, 19.iv.1983, Springmount Stn, c. 13 km from the Mareeba-Dimbulah Rd on the road to Collins Weir (AD); *Conn 1158 & Clarkson*, 26.v.1983, c. 4.2 km by road SW from Herberton along Silver Valley Rd (MEL); *Conn 1228 & De Campo*, 1.vi.1983, E of Baal Gammon Mine, c. 1 km by road, N of Herberton to Irvinebank Rd, c. 7 km W of Herberton (MEL); *Conn 1232 & De Campo*, 28.v.1983, c. 14 km by road, S of Mutchilba, towards Stannary Hills (MEL); *Correll T130*, 4.ii.1971, Siberian Lode, Irvinebank (BRIU); *Correll s.n.*, 4.ii.1971, Irvinebank (BRIU 53300); *Daintree s.n.*, s. dat. Gilbert's River (MEL 101188); *Dallachy s.n.*, 11.vi.1970, Cashmere plains (MEL 101189); *C. Davis s.n.*, iii.1943, 6 miles from Ravenshoe, Mt Garnett Rd (NSW 151908); *Dockrill 653*, 9.ii.1973, Stannary Hills Road (QRS); *Everist 5150*, 24.v.1952, 11 m W of Herberton (CANB); *Domin 3126*, ii.1910, Apud fl. Walsh River (PR); *Domin 8421*, ii.1910, Apud fl. Walsh prope Chillagoe (PR: lectotype); *Domin 8422*, ii.1910, Inter opp. Chillagoe et fl. Walsh River (PR); *Flecker s.n.*, 8.iv.1934, Mt Mulligan (QRS); *Flecker s.n.*, 21.iv.1935, Mt Mulligan (BRI, QRS); *Goodall s.n.*, 30.iv.1961, Flats beside Murphy's Creek (BRI 041115); *Hutchinson s.n.*, 16.ii.1952, Mutchilba via Mareeba (BRI 142220); *Hyland 10358*, 22.iii.1980, Baal Gammon mining lease (QRS); *Hyland 10445*, 5.iv.1980, Baal Gammon mining lease (QRS); *Kenny s.n.*, i.1912, Herberton (BRI 142222, NSW 151909); *McDonald 2*, 6.xii.1970, Bolwarra Homestead (BRI); *McKee 9244*, 21.iv.1962, c. 5 m NW of Dimbulah (CANB, NSW); *Queensland Acclimatisation Soc. 1035*, s. dat. Newcastle Range (MEL); *Staples 2028A*, 25.ii.1975, DPI Experimental Plots, Boomerang Station, via Mt Garnet (QRS); *Stephens (Herb. Flecker 10682)*, 30.xii.1946, Watsonville (QRS); *Vessey 605*, 20.i.1964, Alma den-Lappa (BRIU); *White 1419*, ii.1922, Bullock Ck (Etheridge Railway) (BRI, NSW).

## Specimens aff. ssp. *glaucoviolacea*

QUEENSLAND: *Birch s.n.*, 10.iv.1971, 3 m E of Charters Towers (BRIU S3296); *Morain s.n.*, viii.1967, Ref. 325667 (BRIU S2783); *Morain 144*, 5.viii.1967, c. 6 m E of Lucy Hut on road leading to Oak Hills (c. 60 m S of Mt Garnet) (BRI, BRIU); *Mueller s.n.*, s. dat. Burdekin (MEL 101239); *Staples 2204*, 18.x.1975, Lizard Island (BRI).

d. ssp. *dallachyi* R.M. Barker, ssp. nov.

Subspecies nova *R. adscendens*, a ssp. *glaucoviolacea* differt foliis petiolatis margine crenulata et cystolithis magnis curvatis non nisi ad marginem foliorum, a ssp. *clementii* et ssp. *adscendenti* bracteis bracteolisque glabris, foliis glabris et capsulis glabris.

*Holotype*: *Dallachy s.n.*, 8.ii.1866, Rockingham Bay, Coast Range (MEL 101182).

Erect, ?perennial herb or shrub to 30 cm, not glaucous, with dark green foliage, simple, often rigid, 2-3 branched higher up. *Branches* furrowed, with 2 rows of eglandular hairs confined to outside of furrows on either side of stem, densely beset with small vertical cystoliths either all over or absent from green furrows. *Leaves* on petiole 0.5-2 (-3) mm long; blade broadly ovate, (7-) 10-40 x (3-) 5-25 mm, base broad cuneate, entire or crenulate, apex acute or more rarely obtuse, completely glabrous, upper surface with conspicuous, large, curved cystoliths confined to margin, elsewhere with smaller straight cystoliths at angle of c. 45° to margin. *Bracts* ovate, 5.5-6.5 x 1.0-1.4 mm (see note), dark green, either completely glabrous or with few sparse glandular hairs on central portion, rarely with sparse eglandular hairs on upper half of margin and midrib, cystoliths parallel to midrib all over; hyaline margin present, usually widest in lower half, sometimes in upper half. *Bracteoles* 4-5 x 0.7-0.8 mm, similar to bract. *Calyx* usually longer than bract and bracteole, completely glabrous. *Corolla* 6.5-7.5 mm long along upper side, pink or blue, usually glabrous externally except for eglandular hairs on palate and middle lobe of lowest lip, sometimes a few hairs on style channel. *Ovary*: style 5 mm long. *Capsule* glabrous 4.5-7.3 mm long. *Seed* 0.9-1.2 mm diameter.

*Distribution*

*R. adscendens* ssp. *dallachyi* appears to be confined to the Cardwell Range and adjacent Mt Elphinstone Range (= Coast Range, Blake 1955) in north-east Queensland. Apart from one collection this century from Tully Falls in the Cardwell Range, all other collections were made between 1865 and 1870 by Dallachy from 'Rockingham Bay' and the 'Coast Range'. According to Blake (l.c.) collections from the former locality could have come from Cardwell to as far south as Proserpine. However, as a number of collections specifically mention the Coast Range and Mt Macalister it would seem possible that the range of the subspecies is restricted. Fig. 47.

*Ecology*

Nothing is known of the ecology of this subspecies except that it is from the coastal ranges. Furthermore specimens which approach it most closely (see Note 2) are from neighbouring coastal islands or similar coastal localities between Rockhampton and Cooktown.

*Notes*

1. Ssp. *dallachyi* sometimes approaches both ssp. *adscendens* var. *latifolia* and ssp. *glaucoviolacea* in habit. It differs from the former in its larger flowers and leaves, glabrous capsules and more or less glabrous bracts and from the latter by its petiole, non glaucous leaves. It can also show some resemblance vegetatively to *R. cf. obtusa* from which it can be readily distinguished by the lack of a wide hyaline margin for the whole length of the bract.

2. Collections from neighbouring areas to the main distributional range of ssp. *dallachyi* show affinities to this subspecies while diverging in a number of ways. *MacPherson* 73 from Sinclair Bay and *O'Shanes* 1289 from Table Mountain both diverge in the wider hyaline margin on the bracts and the latter collection also possesses much smaller leaves than normal for ssp. *dallachyi*. *White* 10165 from Hayman Island has some hairs at the apex of the capsule, whereas capsules are glabrous in ssp. *dallachyi*.



A group of collections from Lizard Island have proved difficult to place satisfactorily. The collections approach most closely ssp. *dallachyi*, differing in a sparse indumentum on the bracts and bracteoles, leaves more narrowly ovate than usual and sparse hairs on the apex of the capsule. Two of the collections involved, *Macgillivray* 39 and *Fosberg* 55011, show an approach to ssp. *clementii* by the presence of dense glandular hairs on the green portion of their bracts.

### *Specimens examined*

QUEENSLAND: *Dallachy* s.n., 5.v.1865, Range. Rockingham Bay (MEL 101199); *Dallachy* s.n., 8.ii.1866, Coast Range [Mt Elphinstone Range] (MEL 101182); *Dallachy* s.n., 26.xi.1870, Rockingham Bay (MEL 101221); *Dallachy* s.n., 11.vi.1865, Top of Mt Macalister, Rockingham Bay (MEL 101242); *Dallachy* s.n., 15.vii.1868, Coast Range (MEL 101171); *Stephens* s.n., xi.1947, Tully Falls, 80m S of Cairns (NSW).

### *Specimens aff. ssp. dallachyi*

QUEENSLAND: *Byrnes* 3134, 5.v.1975, Lizard Island (BRI); *Fosberg* 55011, 26.vi.1973, Lizard Island, in low saddle crossing SW third of island (BRI); *Heatwole* 116, 1.x.1967, Lizard Island (BRI); *Macgillivray* 39, 1861, Lizard Island (CANB); *MacPherson* 73, v.1936, Ben Lomond Mt Limestone Reserve, Sinclair Bay (QRS); *O'Shanesy* 1289, 17.iii.1871, Sides of sandstone ranges near Table Mt (MEL); *Specht* L.I.191 & *Specht*, 24.xii.1974, Lizard Island (BRI); *White* 10165, 11.vi.1934, Hayman Island (BRI); *Wrigley & Telford* NQ1290, 17.vi.1972, 3 miles from Point Archer towards Cooktown (CBG).

### e. ssp. 'Irvinebank'

Erect herb, to 25 cm. *Branches* simple or dichotomously branched, woody, furrowed, glabrous, without small cystoliths, not glaucous, not contracted below nodes. *Leaves* sessile, linear, 1-1.5 x 0.1 cm, base attenuate, entire, apex acute, pale green, completely glabrous, upper surface with large curved inconspicuous cystoliths perpendicular to midrib. *Bracts* lanceolate, 4-4.5 x 0.7-1.2 mm, pale green, glabrous, cystoliths not obvious; hyaline margin obscure, widest in lower half. *Bracteole* similar to bract. *Calyx* segments slightly longer than bract and bracteoles, usually with 1-2 eglandular hairs at apex of segments. *Corolla* mauve, 6-7 mm long along upper side, externally hairy on tube and palate, upper lip glabrous. *Ovary*: style c. 4 mm long. *Capsule* glabrous, c. 4 mm long. *Seed*, only immature seen.

### *Distribution*

*R. adscendens* ssp. 'Irvinebank' is known only by a single collection from the Herberton-Irvinebank Road, 6 km east of Irvinebank.

### *Ecology*

The collection is from sandy stony granitic soil in a "narrow-leaved iron-bark woodland with *Acacia* spp. and *Grevillea* sp. understory". It is possible that the proximity to the mine treatment plant accounts for the distinctive habit of the collection. The collection which was made in June is flowering and fruiting.

### *Note*

1. Ssp. 'Irvinebank' has affinities with ssp. *glaucoviolacea* and ssp. *adscendens* var. *junceae*. It approaches ssp. *glaucoviolacea* by its sessile leaves, glabrous capsules and almost glabrous bracts and bracteoles but resembles var. *junceae* in the shape of its leaves and the presence of large curved cystoliths perpendicular to the midrib on the upper surface of the leaves. It differs from the former by its linear, non glaucous leaves and from the latter by its woody branches and the lack of any indumentum on the bracts and bracteoles. It has not been formally described because there is only one collection. The population may have been affected by mining activities in the area and may simply be anomalous.

2. The hairs on the anther backs in these specimens are very sparse and not found on the apex of the upper anther cell as is usual for the Australian specimens of *R. adscendens*, but rather at the top of the connective and the base of the upper anther cell.

### *Specimens examined*

QUEENSLAND: *Staples 080674/6*, 8.vi.1974. Herberton-Irvinebank road, 6 km east of Irvinebank on a hilly plateau above the Loloma Mine treatment plant (0.5 km east). (BRI, QRS).

### Non-Australian material of *Rostellularia* examined

#### 1. *Rostellularia procumbens* s.l.

SRI LANKA: *Hermann s.n.*, s. dat. (LINN. 28.14 — microfiche AD).

BURMA: *McKee 6015*, 8.i.1958, Manwein, Namhkam district (NSW).

TIMOR: *R. Brown s.n.*, 1803, Coepang, (NSW).

CHINA: *Tang Chung Chang 4549*, 6.viii.1926, Black Rock Hill, Foochow and vicinity (NSW).

PHILIPPINES: *Ahern's collector s.n.*, ix. and xi.1905, Rizal, Luzon (NSW) 2 sheets; *Elmer 8440*, iii.1907, Baguio, Benguet, Luzon (NSW); *Merrill (Species Blanconnae 470)*, x.1914, Antipolo, Rizal Province, Luzon (NSW); *Ramos s.n.*, ii.iii.1917, Burgos, Ilocos Norte, Luzon (NSW); *Ramos s.n.*, i.1907, Rizal, Luzon, (NSW).

JAPAN: *Murata 19656*, 20.ix.1965, Honshu. Kitashirakawa, Sakyo-ku, Kyoto-shi (NSW); *Togasi & Matsuoka NSM 104*, 11.ix.1950, Yamashina in Yamashiro (NSW).

MALAYSIA: *Curtis 3099*, ix.1894, Pulau Penang, Coconut Plantation (NSW).

In addition the holdings of this genus in MEL have been examined to investigate whether or not the anther backs are hairy. The following species were examined to determine their relationships with the Australian *R. cf. obtusa*.

#### 2. *Rostellularia peploides* Nees

INDIA: Syntypes: *Wallich s.n.*, s. dat. Ganges banks (K p.p.); *Wallich 2441*, 1820, Rupa Gangis and Rhagulpur (G — herb. DC.: microfiche AD); *Wallich 2441 (Hb Hamilton)*, s. dat., Rhagulpur (G — herb DC.: microfiche AD).

#### 3. *Rostellularia obtusa* Nees

JAVA: Syntypes: *Zollinger 2046*, s. dat. Java (G — herb. DC.: microfiche AD); *Zollinger 2218*, 1846, Java (G — herb. DC.: microfiche AD).

#### 4. *R. mollissima* Nees p.p.

JAVA: *Zollinger 2946*, 1846, Java (G — herb. DC.: microfiche AD). Bremekamp referred Javan material of *R. mollissima* Nees to *R. obtusa* Nees.

#### 5. *R. quinqueangularis* Nees (all syntypes seen in herb. DC. on microfiche in AD)

INDIA: *Wallich 224*, 13.ix.1826, Meaong; *Wallich 224*, 22.ix.1826, road to Petrot Wells; *Wallich 2443*, s. dat., ? E. Hapaulia inferior; *Wallich 2443 (Sillet s.n.)*, s. dat. Without locality; *Wallich 2443 (Rottl s.n.)*, s. dat., Without locality.

### 27. ANISOSTACHYA Nees

Introduced material previously referred to *Rungia latior* by Bailey (1901) does not belong to that genus, but is a tropical African species thought referrable to the genus *Anisostachya* which is another segregate of *Justicia*. The genus has not previously been recorded for Australia and its name is here used with reservation as it is difficult to assess the generic limits of *Anisostachya*. From a brief survey of African literature the relationships of the material to *Monechma*, another African segregate of *Justicia*, should also be investigated. Relationships of the material are further discussed in a note after the species.

*Anisostachya* Nees in A. DC., Prodr. 11 (1847) 368 & 730; Lindau in Engl. & Prantl, Nat. Pflanzenfam. IV, 3b (1895) 329; Benoist, Bull. Soc. Bot. France 110 (1963) 399; Benoist, Bull. Soc. Bot. France 112 (1966) 533. — *Justicia* L. sect. *Anisostachya* (Nees) Benth.: Benth., Gen. Pl. 2 (1876) 1110.

*Type species*: *A. bojeri* Nees from Madagascar.

*Justicia* L. sect. *Betonica* T. Anderson: Clarke in Dyer, Fl. Trop. Africa 5 (1899) 180 p.p. (as to *J. tenella* T. Anders.).

*Rostellularia* auct. non Reichenb.: Nees in A. DC., Prodr. 11 (1847) 368 p.p. (as to *R. reptans*, *R. haplostachya*, *R. tenella* and *R. crenulata*).

*Aetheilema* auct. non R.Br.: Nees in A. DC., Prodr. 11 (1847) 261 p.p. (at least as to *A. rupestre*).

*Micranthus* auct. non Wendl.: O. Kuntze, Rev. Gen. Pl. 2 (1891) p.p. (as to *M. rupestris*): Lindau in Engler & Prantl, Nat. Pflanzenfam. IV, 3b (1895) 298 p.p. (as to *M. rupestris*).

*Rungia* auct. non Nees: Lindau, Bot. Jb. 22 (1895) 120; F.M. Bailey, Qld Fl. 4 (1901) 1150.

*Justicia* auct. non L.: Heine, Fl. W. Trop. Africa 2 (1963) 427 p.p. (as to *J. tenella*).

Herbs. *Leaves* petiolate, ovate, connected across each node by transverse ridge. *Inflorescence* a compound system of axillary, long pedunculate, dense, cone-like spikes of overlapping bracts. *Bracts* 4-ranked, orbicular or obovate, often membranous. *Bracteoles* 2, smaller than bracts. *Calyx* segments 4, with remnant of fifth segment. *Corolla* small, 2-lipped; upper lip with style channel entire; lower lip 3-lobed, palate behind middle lobe. *Stamens* 2; anthers 2-celled, cells inserted at unequal levels, lower cell with long white basal spur. *Ovary* 2-celled, 2 superposed ovules per cell; stigma notched. *Capsule* club-shaped, seedless at base, 2 well-developed seed-bearing hooks per valve. *Seed* disc-like, short white hairs all over which expand on wetting.

### *Distribution*

The major part of this genus is apparently confined to Madagascar where Benoist (1963, 1966) described 35 new species. The total extent of the genus is unknown, but *A. tenella* is a common tropical African species and its occurrence in Australia must be regarded as an introduction.

*Anisostachya tenella* (Nees) Lindau in Engler & Prantl, Nat. Pflanzenfam. IV, 3b (1895) 329; *Rostellularia tenella* Nees in A. DC., Prodr. 11 (1847) 369. — *Justicia tenella* (Nees) T. Anderson, J. Linn. Soc. Bot. 7 (1864) 40; for numerous synonyms used outside Australia, see Table 19.

*Types*: *Bojer s.n.*, ? 1839. In pratis humidis inter saxa prov. Emirnae insulae Madagascar. (G-herb DC.: microfiche AD); other types n.v. in Herb Hooker and Huedelot.

*Rungia latior* auct. non Nees; F.M. Bailey, Qld Fl. 4 (1901) 1150.

Small trailing herb, rooting at nodes, branches glabrous apart from two lines of appressed eglandular hairs. *Leaves* with petioles slender, 10-16 mm long; blade ovate to more or less circular, 20-30 x 12-20 mm, more or less attenuate base, entire, obtuse apex, glabrous, small cystoliths on both surfaces, more noticeable on upper. *Inflorescence* a series of dense spikes, each 1-2 cm long, arising in pairs from upper axils on slender peduncles 10-17 mm long; flowers sessile in axils of two of bract rows, absent from other two rows. *Bracts* obovate, 4-4.5 x 2.5-3 mm, base cuneate, apex obtuse with short apiculum, glabrous, somewhat membranous,

without hyaline margin except sometimes on very edge of margin, 5-veined. *Bracteoles* lanceolate, shorter than calyx, c. 1.6 mm long, one closest to fertile bract with small subsidiary bracteole at base. *Calyx* segments lanceolate, cohering at base, c. 2.5 mm long, glabrous apart from sparse eglandular hairs particularly on midrib. *Corolla* c. 2.5 mm long, ? bluish-white, upper lip triangular, c. 0.9 mm long, style channel with two rows of eglandular hairs at base; lower lip c. 1 mm long, fine eglandular hairs at base of palate in tube, filaments decurrent as lines of eglandular hairs in tube. *Stamens* with filaments 0.7 mm long, glabrous; anther cells glabrous on backs, upper cell ? shortly spurred. *Disc* annular, ? 2 rectangular appendages on rim. *Ovary* ellipsoid, glabrous apart from conspicuous, long-stalked glandular hairs at apex; style c. 1.2 mm long, glabrous; stigma ? unequally shortly lobed. *Capsule* 3-4 mm long, glabrous apart from few glandular hairs at apex, 4-seeded, seed-bearing portion slightly expanded, apex acute.

Distribution

*Anisostachya tenella* is found throughout tropical Africa. The single Australian collection from Kamerunga near Cairns made in 1891 was presumably an introduction. Bailey (1901) stated that the species had “become naturalized”, but I have seen no subsequent collections from this area.

*Ecology:* Nothing is known of the ecological preferences of this species.

Notes

1. *A. tenella* appears in the Queensland Flora (1901) as *Rungia latior* Nees. The plant bears a resemblance in habit and inflorescence to the genus *Rungia* as exhibited by Lindau’s (1897b) description of African material of the species as *Rungia baumannii*. It differs from it in not possessing white-margined bracts and capsules in which the placentae rise elastically (similar to the *Dicliptera*-type capsule illustrated in Fig. 31).

Species Name	Author and Date of Publication	Tribal Placement
<i>Aetheilema rupestre</i>	Nees 1847a	Ruellieae
<i>Rostellularia tenella</i>	Nees 1847a	Justicieae
<i>Rostellularia crenulata</i>	Nees 1847a	Justicieae
<i>Rostellaria parviflora</i>	Bentham 1849	Justicieae
<i>Rostellaria tenella</i>	Bentham 1849	Justicieae
<i>Micranthus rupestris</i>	O. Kuntze 1891	Ruellieae
<i>Micranthus rupestris</i>	Lindau 1895	Ruellieae
<i>Anisostachya tenella</i>	Lindau 1895	Justicieae
<i>Rungia baumannii</i>	Lindau 1897a	Justicieae
<i>Phayloopsis rupestris</i> (“Phaulopsis”)	Lindau 1897b	Ruellieae
<i>Justicia tenella</i>	T. Anderson 1864	Justicieae

Table 19: Previous names used for *Anisostachya tenella*

2. As stated in the introduction to this genus, it is by no means certain that *Anisostachya* is the most appropriate position for this species. The species has already had a long history of confused placement within a number of genera, shown by the list in Table 19. It was first described by Nees (1847a) within the genus *Rostellularia* (as *R. tenella* and *R. crenulata*) of tribe Justicieae and also as *Aetheilema rupestre* within the tribe Ruellieae. Subsequently it has also been recorded within the genera *Micranthus* and *Phayloopsis* of tribe Ruellieae (O. Kuntze

1891, Lindau 1897) and *Anisostachya* (Lindau 1895) and *Rungia* (Lindau 1897a) of tribe Justicieae.

The species possesses characteristics of both tribe Ruellieae and tribe Justicieae, agreeing with the former only by the presence of hairs on the seed which expand on wetting, but agreeing with the latter by its 2 stamens with unequally inserted anthers and its 4-seeded capsule. Thus, it possesses more of the characteristics of tribe Justicieae than tribe Ruellieae. Of the genera referable to tribe Justicieae, as already shown (Note 1) the material cannot be referred to *Rungia* as it lacks the distinctive "*Dicliptera*-type" capsules. It does approach *Rostellularia* in its characters but differs in possessing axillary, condensed spikes rather than terminal, less condensed spikes and the bract and bracteoles differ in arrangement.

The genus *Anisostachya* seems the best repository for the species at the moment. *Anisostachya* (tribe Justicieae) was first described by Nees and has subsequently been variously recognised as a distinct genus (Lindau 1895) or as a section of Justicieae (Bentham 1876). Benoist (1963, 1966) described 35 new species from Madagascar within this genus, but in other African floras (Clarke 1900, Heine 1963) the species has been referred to as *Justicia tenella*. Unfortunately Benoist provides no generic description, no key to the species he recognises and the seed is not described in any of his species. Other species referred to *Anisostachya* by Lindau (l.c.) cannot be found in modern floras. Therefore, it is difficult to be sure that the correct generic position has been found for the species when treating *Justicia* in the narrow sense.

This is particularly evident when comparing the characteristics of this species with those of another and earlier published segregate genus of *Justicia*, *Monechma*. Using Clarke's (1900) descriptions, *Anisostachya tenella* would differ from *Monechma* only by its 4-seeded capsule; this genus needs to be investigated with *Anisostachya* as a repository for the species. Since the combination *A. tenella* already exists I have chosen to use this name until the matter is resolved.

#### *Specimens examined*

QUEENSLAND: Cowley 9, viii.1891, Kamerunga (BRI).

*Rungia latior* specimens seen (all syntypes).

INDIA & CEYLON: Gardner s.n., 1847, Nufferies (K: 2 sheets — 1 p.p.); Wight 2284, iv.1846, Chisfrauray (K: 2 sheets — 1 p.p.).

### 28. JUSTICIA s.l.

*Justicia carthagenensis* Jacq., species sedis incertis

*J. carthagenensis* Jacq. was included by Bremekamp (1948) among a group of species of *Justicia* s.l. which could not be placed satisfactorily in his segregate genera. Most of these species had already been treated by Nees von Esenbeck (1847a) under *Adhatoda* sect. *Tyloglossa*. Bremekamp considered sect. *Tyloglossa* to be an unnatural assemblage of species as confirmed here in the discussion under *Calophanoides* (p. 235). Instead *J. carthagenensis* was thought by Bremekamp (l.c.) to form a natural group with *Beloperone violacea* Planch. & Lindley, *B. ciliata* (Seem.) Hook and possibly *J. periplocifolia* Jacq., *J. lithospermifolia* Jacq. and *J. furcata* Jacq. This group differed from true *Beloperone* and also *Adhatoda*, according to Bremekamp, and seemed referable to a new genus. As the species all belong in America or Africa where *Justicia* is used in the broader sense, this suggestion has never been taken up. *J. carthagenensis* does not belong with any of the segregate genera recognised here for Australia. It differs from all of the genera, by the lack of a tail on the lower of the two anther cells, from

all except *Anisostachya*, by the possession of more or less smooth seed with minute hairs, and from all by the spatulate bracts and the extremely large flower. Its true position will have to be decided by workers in the *Justicia* s.l. complex who are concerned with American species.

***Justicia carthagenensis*** Jacq., Enum. Pl. Carib. (1760) 11: n.v.; Bremek., Fl. Surinam 4 (1938) 241; Bremek., Verh. Kon. Nederl. Akad. Wetensch., Afd. Natuurk. 45 (1948) 53; Leonard, Contrib. U.S. Natl. Herb. 31 (1958) 547; Gibson, Fieldiana: Bot. 24 (1974) 386. —*Adhatoda carthagenensis* (Jacq.) Nees in A. DC., Prodr. 11 (1847) 403.

*Type*: n.v., possibly in BM, LINN or W.

*Beloperone violacea* Planch.: Hook. in Curtis, Bot. Mag. 87 (1861) t. 5244.

*Justicia sanctae-martae* Lindau, Engl., Bot. Jb. 21 (1895) 377.

Erect herb to 20 cm high, with cystoliths. *Branches* 4-angled, sulcate, glabrous. *Leaves* with petiole c. 1.5 cm long; blade ovate, 7 x 3.5 cm, base tapering, undulate, apex acute or acuminate. *Inflorescence* a dense terminal spike, interrupted at base, consisting of single flowers in axils of single bract and two bracteoles. *Bracts* more or less spatulate, 16-20 x 7-10 mm, covered with eglandular hairs, near apex with glandular hairs; apex sometimes apiculate. *Bracteoles* elliptic, 11.5 x 3.5 mm, sparse eglandular hairs mixed with few glandular hairs. *Calyx* segments 10.3 x 2.2 mm, white-margined, acute, covered by eglandular hairs. *Corolla* purple, covered externally with fine eglandular and glandular hairs; tube 1.5 cm long, internally with V-shaped row of eglandular hairs at base; upper lip 1.5 cm long, triangular, style channel pubescent at base; lower lip 3-lobed, palate similar to other genera in *Justicia* s.l. *Stamens* 2, exserted; filaments c. 14 mm long, glabrous; anthers 2-celled, 2.8 mm long, cells superposed, minutely awned at base, connective oblique. *Disc* extremely thick, annular, undulate margin. *Ovary* 2.5 mm long, glabrous except at apex, style c. 22 mm long, pubescent in basal half, glabrous above, stigma shortly 2-lobed. *Capsule* ellipsoid, 11.5 x 5 mm, longitudinally furrowed on middle outer surface of two halves, pubescent, 4-seeded; seed-bearing hooks prominent. *Seeds* somewhat compressed, c. 2 mm diameter, puberulent.

### *Distribution*

*J. carthagenensis* is known in Australia only by a single collection from near the Botanic Garden, Darwin. The species is tropical American in origin, but whether it has become naturalised is not clear from the information on the label of the collection.

### *Ecology*

The Australian collection came from a patch of rainforest. In Guatemala the species is recorded from "damp thickets" and "along rivers in forest" (Gibson 1974).

### *Note*

Gibson (1974) states that *J. carthagenensis* has "served as a repository for various divergent elements, including *J. corynimorpha* D. Gibson, with clavate bracts and shorter corollas (1.5-2.5 cm)". Comparison of the specimen from Darwin with Gibson's description of *J. corynimorpha* and *J. carthagenensis* is shown in Table 20.

Gibson further makes the statement that there are "a number of collections from the low, humid areas (sea level to 900 m) of the Yucatan, West Indies, Nicaragua, and Costa Rica that have ovate-cuneate to clavate bracts, as in *J. corynimorpha*, but they also have ovate to elliptic-ovate leaves, longer corollas, and longer anthers, as in *J. carthagenensis*". Thus it would seem from comparison with the table that Australian material might correspond with specimens which are somewhat intermediate between *J. carthagenensis* and *J. corynimorpha*.

Character	<i>J. carthagenensis</i>	<i>J. corynimorpha</i>	Australian specimen
Altitude	1000-2200 m	200-900 m	sea level
Bract shape	strap-shaped	clavate to spatulate	spathulate
Bract indumentum	—	short pubescent glabrate, sometimes glandular	pubescent with glandular hairs near apex
Bract length	14-20 mm	7-13 mm	16-20 mm
Calyx length	10-15 mm	5-8 mm	10.3 mm
Corolla length	3-4 cm	2-2.5 cm	c. 3 cm
Capsule length	c. 20 cm	10-15 mm	11.5 mm
Seed	smooth	minutely puberulent	minutely puberulent
leaf dimensions	4-16 x ?	4-12 x 1-2.5 cm	7 x 3.5 cm
leaf shape	ovate to elliptic-ovate	narrowly oblong, lanceolate-oblong or elliptic	ovate
anthers (lower cell)	calcarate	minutely calcarate	minutely calcarate
anther length	3 mm	c. 2 mm	2.8 mm

Table 20: Comparison of Australian material assigned to *J. carthagenensis* with Guatemalan material of *J. carthagenensis* and *J. corynimorpha*.

# *Specimens examined*

NORTHERN TERRITORY: *Mitchell s.n.*, 1.iv.1976, Patch of rainforest in Botanic Gardens behind St John's College (NT).

## GENUS ET SPECIES EXCLUDANDA

1. *Strobilanthes tatei* F. Muell., Trans. Roy. Soc. S. Austral. 5 (1882) 81 = *Clerodendrum* (Verbenaceae)

*Lectotype here designated: Tate s.n.*, 1882, Mackinlay River (MEL 602001); *isolectotype*: (AD p.p.).

The collections *Tate MEL 602001* and *Tate 7* on which Mueller (1882b) based his description of *Strobilanthes tatei* contain only fragments, both having a small branch with a few leaves and both with dissected flowers in small envelopes. The MEL material is mounted with Mueller's rough Latin description of the species, while the AD material is mixed with another species of similar habit vegetatively (*Foelsche 14*). The original description refers to the leaves as "scantly indented" or "entire at the margin", a description which is more appropriate to the MEL material, as the AD material (*Tate 7*) has 2-3 definite teeth along each side. Thus the MEL material has been designated as lectotype of *Strobilanthes tatei*.

Foelsche, in 1883, sent extra material which Mueller has annotated as *Strobilanthes tatei* and added in pencil to the description mounted on the MEL material, that the flowers are white. Two of these three collections, *Foelsche 29* (with "flowers white with red spots") and *Foelsche 122* are of the same taxon as the type, but *Foelsche 14* ("flowers white"), although resembling it vegetatively, has five stamens (or four stamens plus a staminode) not four, is either glabrous or scantily hairy in the corolla tube compared with the dense beard in the type, and has shorter almost elliptical anthers which are not so far exserted compared with the longer, linear, far exserted anthers of the type.

All material clearly belongs to *Clerodendrum* (Verbenaceae). A.A. Munir (pers. comm. 1982) has tentatively placed it under *Clerodendrum holtzei* F. Muell. pending further investigation by him.

*Specimens examined*

NORTHERN TERRITORY: *Foelsche* 29, i.1883, Yam Ck (MEL); *Foelsche* 122, vi.1883, Finnis River (MEL); *Foelsche* 14, i.1883, Yam Creek (MEL, AD p.p.); *Tate s.n.*, 1882, Mackinlay River (MEL 602001 duplicate of Tate 7); *Tate* 7, 1882, 12 mile camp, Arnheim's Land (AD — p.p.)

2. *Basileophyta fredericiaugusta* F. Muell., First General Report of the Government Botanist on the Vegetation of the Colony (1853)16. = *Fieldia australis* A. Cunn. (Gesneriaceae).

## VIII. Acknowledgements

This project was partially supported by a grant from the Australian Biological Resources Survey.

With the revision being carried out in Adelaide and the plants growing at the opposite end of the continent the opportunities for field work were limited. However, I would like to thank Karen Wilson and the National Herbarium of New South Wales for providing me with the opportunity of seeing a number of taxa in the field, particularly in the Northern Territory, on what proved to be a very enjoyable and productive field trip. In addition, thanks are due to Mr John Clarkson of Mareeba, Mr Kevin Kenneally of PERTH, Mrs Sooty Hall of Wittenoom, Mrs Val Hando of Chillagoe, Mr David Gordon of Glenmorgan and Mr Clyde Dunlop and Mr Glen Wightman of DNA for their efforts in making and despatching collections of Acanthaceae to me on request.

Between submission of the manuscript and publication I was based at K for eight months. This enabled me to visit a number of English and European herbaria and my thanks are extended to the staff of these institutions for their assistance. Some minor modifications were made to the manuscript during this time and I am obliged to Dr Dick Brummitt and Dr Vicky Graham for discussions at K and to Dr Charlie Jarvis of BM for discussions on Linnaean typification.

The help and support of the staff of the State Herbarium of South Australia is gratefully acknowledged. More particularly however should be mentioned the help of the librarian Ms Gaye Denny, the typists Ms Barb Welling and Tina Eadsforth, and the artist Mrs Beth Chandler. All four have been unfailingly cheerful and helpful throughout the duration of this project.

There remains only my family to thank. Without their cooperation, particularly that of my husband Bill the project would never have been finished. Despite his own work load, Bill cheerfully accepted the responsibility of house and family during my 6 week field trip, and he has throughout this project provided support, encouragement, discussion and constructive criticism of the manuscript; my deepest gratitude, Bill.

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